SCIENCE

New Series
Vol. 95, No. 2471

Friday, May 8, 1942

Subscription, $6.00
Single Copies, .15

Science: published weekly by The Science Press, Lancaster, Pa.
Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

No. 24

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Vol. 95 FRIDAY, MAY 8, 1942 No. 2471

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

CONSERVING OUR HARVESTS[1]

By F. C. BRADFORD

U. S. DEPARTMENT OF AGRICULTURE, GLENN DALE, MD.

THREE and a half centuries ago Francis Bacon said "I take all knowledge to be my sphere." Though competent scholars state that Bacon was far from having full knowledge of the science of his day, his aspiration was not ridiculous or even particularly remarkable in his time, and had he given to science half the time he devoted to statecraft he might well have mastered all the science that was then known. An Italian contemporary of Bacon, Giambattista della Porta, made studies which are still mentioned in histories of optics, included in his extensive "Magia Naturalis," a chapter on producing new plants—probably the first organized article on plant breeding—wrote a work on plant signatures and in modern literary histories he is discussed as the leader of the notable group of writers of Italian comedies in a period when Italian comedy was the most notable literary movement in the world. A century later the best-known English writer on gardening, John Evelyn, by whom greenhouse heating was considerably advanced and gardening made respectable, was only a part-time horticulturist; he was also an authority on some of the fine arts and rather constantly engaged with public affairs. Most of the German pomologists of the early nineteenth century made their extensive varietal studies and wrote their monumental works in time spared from their labors as pastors or teachers. When our own agricultural colleges and experiment stations were organized, nearly two centuries after Evelyn, full-time horticulturists were rare in their

[1] Address of the president of the American Society for Horticultural Science, Dallas, Texas, December 30, 1941.

staffs; most of the pioneer teachers and investigators not only worked on the various phases of horticulture, but also served either as botanists, entomologists or pathologists and sometimes as foresters and superintendents of grounds. Many horticulturists now in active service have taught or investigated pomology, olericulture, greenhouse construction, floriculture, plant breeding and landscape gardening. They have in numerous cases seen one-man departments grow into sectionalized departments, with staffs of 20 to 30 men.

The two needs most conspicuous when this expansion began, research and extension, have received most attention, with results that are most gratifying. The successive volumes of *Proceedings* of this society provide a graphic presentation of cumulative increase in horticultural research. If all vehicles of publication of horticultural investigation were considered, the equation representing the increase might approach that of accelerated motion. Increase in horticultural research is not confined to the United States. Many other nations have research stations doing work of a high order, most of them comparatively new. As an example, it may be noted that pollination studies on the Bartlett pear have been reported in Australia, Canada, South Africa, Switzerland, Germany, England, the Scandinavian countries, the United States and possibly other countries. There need be no concern about quantity.

The *Proceedings* of this society also illustrate very well a great improvement in the quality of the work done; the increasingly frequent appearance of articles by horticulturists in the journals of the pure sciences furnishes additional evidence of the quality of the research done in horticultural departments and, conversely, physiologists and anatomists are increasingly utilizing horticultural material in their own research. It is true that improvement in quality is still needed, here and there, but the best promise of that improvement is the self-examining attitude of research workers, and their concern for the quality of their work. Some improvement in choice of problems, more concerted attack from various angles, are needed, but these concern direction of research primarily, rather than its excellence.

On the whole, then, our research work is sound and with proper support can be relied on to continue in that condition, so far as present signs are indicative.

The very productiveness of research and its advanced nature have, however, created a new problem, rapidly becoming acute, through the inadequacy of the existing mechanism to the task of digesting and assimilating research results, incorporating them into the existing body of information, with such modifications of this body as they may necessitate, to the end that the whole body of information is always complete and always ready for use. Thirty years or so ago, this problem was much less pressing. There is abundant evidence that the horticultural teaching of that period was far from utilizing all the information then in existence, largely because it was not in readily available form, and the horticultural teacher of those days had too many subjects to cover to permit him to develop any subject thoroughly by library research. In spite of this failure to utilize existing information already stored on library shelves, the horticultural investigator and teacher had no great difficulty in keeping abreast of current investigations on horticultural crops. The first comprehensive American experiments on orchard fertilization and orchard management were just approaching publication; spraying employed only three or four standard materials; the first serious studies on storage were still new. Most of the experiment station work was published in bulletins and these were so few that each one was studied and discussed by all horticultural investigators and teachers. The average investigator of that period worked on projects covering nearly the whole range of horticulture and could keep abreast of current literature on all of them without losing much sleep. A volume of the size of any of our *Proceedings* would contain all the horticultural research published in several years in the earlier period.

Thus little more than thirty years of horticultural research and teaching have developed a stage of specialization so advanced that in the institutions with the larger staffs each member, it has been said, continually knows more and more about less and less. Sheer abundance of information is increasingly circumscribing the field in which each man can keep thoroughly or even well informed. In many fields the investigator could spend so much of his time reading pertinent literature that he would have scant time for research of his own. It is doubtful whether any student of hormones could read all the papers on hormones that have been printed in the last ten—or even five—years and still do research. The student who would read all current literature on citrus fruits in the original papers would need command of at least English, French, German, Spanish, Portuguese, Italian, Russian, Dutch and Japanese. If the literature on limited fields taxes or exceeds the time and energy of the specialist in those particular fields, it is manifest that he must fail to keep well acquainted with related fields and his reference to them throughout his working life is in many cases based on what he learned in college.

Changes in the techniques of investigation have been even greater than those in quantity. Chemical methods, plant physiological techniques, virtually un-

known in horticultural investigation 35 years ago, have become common. Statistical analysis was then new in the biological sciences, and no horticultural research had been placed under its scrutiny. Genetics was a new term. Little was known about plant viruses. Each of these techniques is ever progressing, each has its own growing literature. Thus modernization of implementation requires that the investigator be constantly alert; this in itself is a considerable task. The increasing requirements of attention to methodology inevitably limit the time available for thoughtful study of literature of those phases of horticulture that do not occupy the investigator at the moment. Little by little each of us has been forced to neglect readings we should accomplish. No other course is open. That we may retain even approximately complete command of some subjects, we must leave others rather largely in status quo, and before long our occasional dealings with them are made with incomplete knowledge.

Wisdom is not a new invention. If research is sound its value is not ephemeral. None the less the very machine that was created to produce facts is by its own exacting requirements and its productivity burying facts under other facts unless they have an immediate cash value. It would be very comforting could we believe that some vaguely defined buoyancy kept everything valuable afloat on the surface while the trivia were engulfed; unfortunately this is not the case. Discoveries of great value have been ignored because their importance seemed small at the moment of their enunciation. When Nicholas Longworth induced the son of a Cincinnati market gardener to reveal the secret of securing crops from pistillate strawberries, the use of pollenizers quickly became general and was not forgotten, because pistillate varieties were being grown commercially. This "secret" had, however, been published in England in 1815 and in France nearly 50 years earlier than that and had been forgotten because it had no important immediate application. These reports were not in obscure journals; one had been published in the Transactions of the Royal Society; the other in a standard book. Mere publication evidently is not enough to insure continued recognition.

We who are here present will collectively hear literally hundreds of papers at this session; these will be neatly printed and the collection will take its place on library shelves, alongside thirty-odd similar volumes. But this is not the end. Research will not die with the closing of this session. Another volume will be added next year and the next and so on. The students who come into the field in 1951 will be so busy reading the new volumes that few of them will ever get back along the shelf to the 1941 volume unless specific reference sends them to it. Thus the study that can not at once be tied to something useful can become buried in 1941 as in 1760. If this material is worth the time, effort and resources that have gone into its preparation and publication, it is worth the additional effort that will be necessary to keep it accessible.

This confusion—if not chaos—into which we are proceeding at a rapid rate is due to our failure to recognize our increase in wealth. We are still using the machinery and methods that were reasonably adequate 40 to 50 years ago, unconscious that we have outgrown them.

Specialization has beyond question been productive of good results, but doubt may well be raised as to whether, in its present form, it can continue to function smoothly when the influence now exerted by the older men with broad experience is no longer felt. Already there are disturbing signs. Sometimes recommendations are made to alleviate one difficulty, without due consideration of all the effects of these recommendations, simply because the other effects lie beyond the specialist's purview. When staffs are composed entirely of specialists the lack of integration is likely to become acute. On the other hand, wide areas, thousands of farmers, still take their immediate guidance from horticultural staffs so small that one man may be their reliance in a wide diversity of subjects as, conceivably, rootstocks, winter injury, boron deficiency and fruit storage. A position with this responsibility needs a more capable man than is required for any single position in a large staff. Usually a man in this situation has the most meager library facilities and the greatest imperative demand on his time. It is not surprising, therefore, that in occasional cases a practical grower has quoted published research of which the investigator had not heard.

This condition has developed, obviously, through nobody's intent and many are still unaware of its existence. The investigator naturally does not advertise his failures to keep fully abreast of the times. The administrative official can not know many fields as well as the specialists in those fields know them, and as long as their work is good he must assume that it could not be better. If he has suspicion that some phases are being neglected his usual remedy is to hire another investigator.

Responsibility for this situation rests basically even more on the colleges of agriculture than it does on the experiment stations. They have followed the pure sciences in exalting the investigator and ignoring the scholar. The whole structure of the requirement for the advanced degrees—particularly the doctorate—in agricultural subjects as in pure sciences reflects this with the greatest clarity. In the days when advanced

degrees were first awarded, the literature of science was so comparatively limited that mastery of it was easily attained by the candidate and his thesis was required to demonstrate his ability to conduct independent research. Thus, the early doctors of philosophy could legitimately claim to be scholars and investigators. For some time it has been apparent that doctorates are being awarded to men who do not know thoroughly the literature of even their own science beyond the field of their theses, but no official recognition has been made of the polite anachronism involved in welcoming doctors of philosophy into fellowship of scholars. Despite the great change in lines of work followed by graduates of agricultural colleges, despite their influx into industries connected with agriculture, the graduate student who wishes a degree, whatever his purpose, must still demonstrate his ability to conduct independent research. A teacher in a Smith-Hughes agricultural high school who wishes to supplement the studies covered in his undergraduate curriculum may need advanced courses in many branches of agriculture, but if he wishes the master's degree as a token of extra study beyond the baccalaureate degree he must abandon thought of advanced courses in various agricultural subjects, concentrate on one and demonstrate through a thesis that he can conduct investigation. When he has done this, he may secure an increase in the stipend he is paid for teaching. A youth contemplating a career in industries related to agriculture is likely to secure better preparation for this career by taking the bachelor's degree in two institutions than he will by taking graduate work. Many respectable institutions are now conferring the master's degree for advanced course work, but agricultural colleges rather uniformly seem to be content to pour all their material into the old moulds. Agricultural study was once hailed as an escape from the rigid requirements of the old classical curriculum; with age it seems to become rigid in its own way.

Every institution which awards the doctorate in literature and in history grants it for work which in the scientific field would be called discussion of the literature. There is no question of the value of this kind of work or of its repetition; the factual records of history may not change, but their interpretation changes with every generation. Only in pure science and in agriculture is this type of study without formal recognition. Official agriculture, whose every effort is sincerely in the direction of making the world's knowledge available to the humblest farmer, expends great effort on research and in extension but assumes that systematization of information is an autocatalytic reaction.

Were the effects of this present traditional grooving confined to the misfortunes of the individual students who do not fit into it, they would be deplorable enough. Actually they reach much farther and affect us all. The standard requirement for the advanced degree exalts research work and inevitably establishes some unfortunate implications of relative values of different legs of the table. This notion is all too common. Naturally it leads to differences in preferment. Extension men have their methods of securing reward, often through "pressure groups," and administrative officials appear to secure a glow of mellow feeling from rewarding the work of the successful research man, who, presumably, exerts no pressure. When these groups are cared for, if there is any balance, part of it is given to the teachers—unless the campus needs new sidewalks. Scholarship fares better in the humanities than it does in the sciences—or in agriculture.

Thus the cycle is maintained. The horticulturist soon becomes aware of the directions in which lies preferment and he "builds his fences out in the state" or he pushes his research—in any case he neglects his teaching in greater or lesser degree. The bright ambitious young man seeks ardently for full-time research or goes into extension, and the passing of time finds considerable numbers of men doing teaching because they were complacent and lacked aggressiveness, rather than through any special aptitude. Teaching done by the research man is all too frequently very minute, detailed and exact in the portion of the course that pertains to his particular field of research and very shabby in the other portions. Sometimes two thirds of the student's time in the course is given to the teacher's research field and the remaining third to the rest of the subject. This is an easy way of discharging an unwelcome task.

Unfortunately a teacher's success can not be measured accurately until the students he had in his middle age have themselves become middle-aged. Administrative officials have some real difficulty in this appraisal, for they can not widely rely very much on student opinion. They could, however, assure themselves that the candidate teacher is a scholar through the guarantee of his mastery of the literature of his subject that is implied in a degree awarded for scholarship, far better than by his standing as an investigator of a limited portion of the subject he teaches. Attainment of a degree awarded for scholarly mastery of a subject, without reference to research proficiency, should be the preferred standard for selection of teaching personnel. Were all agricultural students prospective investigators, the present arrangement would be satisfactory; they are not, and it is not.

Scholarly systematization of knowledge and its

publication could well form a part of the program of every institution. Publication of such works should not drain seriously the publication funds, for if proper standards are maintained, contributions of this sort will be far less numerous than the research papers. Publication of critical literature reviews would have several beneficial effects; it would make readily accessible in a few minutes information whose gathering and collation required months and years; it would grant recognition to those who perform these labors and it would invite appraisal of the quality of their work, as do the papers written by investigators. Unwisely executed, this effort would be perilous for it could become misleading. High standards should be exacted and consultation with many specialists would be necessary; the work should be critical review and not unquestioning compilation.

The influence exerted by men whose chief responsibility and greatest distinction lay in providing complete, digested and evaluated information would be felt in many directions. It would constitute a strong force in a direction needed now more than ever, namely, coordination of research. It would relieve investigators of much of the labor of searching through great masses of reading to glean a small grist of pertinent matter, though it should not relieve them of responsibility for study of this modicum. More than one productive new line of investigation has been suggested only after assembly and review of all the available pertinent facts. With specialization becoming more advanced, men of this somewhat more general training could be of great value to administration of horticultural organizations.

Investigators are relying increasingly on abstract journals to bring their general information down to date. Therefore it is most humiliating to be forced to acknowledge that lack of support is making abstract journals increasingly inadequate. To secure reasonably complete coverage of horticultural literature, its student must resort to foreign abstract journals, admirably conducted, but still abstracted abroad and principally for use abroad. As a rule, abstracting done abroad is a paid service; in the United States it is almost entirely voluntary. This may have some influence on the results, but much more inhibitory on the usefulness of our abstract journals is the limit placed by lack of funds on the space that can be allotted to any subject. This situation could doubtless be remedied by proper presentation of the value of the service and of its present inadequate coverage. It is possible, too, that abstract journals could increase their usefulness and their revenues by adopting a format lending itself to printing and sale of reprint separates that could be distributed readily into various files.

Though improvement of our abstract journals is very important and should be pushed energetically, principally by better support, these journals can not, however well conducted and however voluminous, be more than an adjunct in keeping our information continuously organized. Let any one who doubts this statement drop all pertinent notes on any one subject into a file for ten or even five years, and then try to comprehend the mass in time to answer a telephone call. Librarians' lists of titles give only a start in this direction, for titles are often misleading as to content. Sporadic literature reviews introducing reports of investigation are increasingly inadequate, for they properly ignore material not relevant to the investigation and they do not constitute a uniform progression covering a whole field. Whatever devices may be tried, there is no escaping the need of men trained in horticultural scholarship. These men should know the art of horticulture and know the supporting sciences; their linguistic attainments should be extensive; their geographic and historical knowledge should be adequate to permit evaluation of any piece of research in relation to its background; they should be proficient in finding, collating, organizing and presenting information. They should find their chief delight in doing work of this nature. They must be able to consult freely with appropriate specialists for critical evaluation of research reports. This is, to be sure, almost the identical set of specifications that should be used in developing a good teacher. It involves far more, however, than it did a few years ago in preparation, attainments and experience and it deviates rather considerably from the work reasonably expected of an investigator. That it is not often realized at present is due to our persistent effort to make teachers out of men trained to be investigators. Work of this sort needs, therefore, official recognition as a definite career, honored equally with cognate lines of effort, with a definite line of approach, a definite outlet for its products, definite allowance of time and resources for its pursuit and definite reward for excellence in attainment. The man thus trained and thus employed could well become more than a specialist engaged to cure the effects of specialization; he is the most likely of all to develop into the architect who builds structures from materials made by many men. Let us remember that Darwin accomplished as much or more by putting together scattered bits of information brought forth by others than he did by his own personal investigations.

UNVEILING OF THE BUST OF HENRY FAIRFIELD OSBORN AT THE AMERICAN MUSEUM OF NATURAL HISTORY[1]

THE unveiling of the bust of Henry Fairfield Osborn and the opening of the new Hall of North American Mammals are appropriately brought together in one meeting. To Osborn's enthusiasm and unconquerable energy we owe this entire memorial building, dedicated to his friend and fellow-naturalist, Theodore Roosevelt. This building in turn forms a perfect setting for the new hall, which is filled with superb mounts of the larger North American mammals in their native haunts—beloved alike by Roosevelt and Osborn. Finally it was Osborn's life-long admiration of the larger mammals, living and extinct, which attracted to him such men as Madison Grant, Harold E. Anthony and James L. Clark, who have made Osborn's dream a glorious reality.

Osborn's scientific studies on fossil mammals began in 1877, when he and several of his classmates at Princeton, including his close friend and colleague, William Berryman Scott, made their famous first expedition to the Bridger Eocene basin of Wyoming. Here they discovered enough strange extinct forms of mammalian life to give them an uncontrollable urge to discover more. From this expedition sprang a long and ever-branching system of explorations, at Princeton under Scott and at the American Museum under Osborn. From the Flaming Cliffs of the Gobi Desert and the withering slopes of the Siwaliks in India to the frozen soil of Alaska, many a "valley of dry bones" has heard the clang of the explorer's pick and yielded up its dead. Under the spell of the prophet the dry bones came together and thus it happened that in our temple of science many an ancient leviathan rears his mighty frame before us.

All this and much more was set in motion by Osborn, who often went into the field himself; but he always gave full credit to his captains and other men whom he had inspired and trained in the science of paleontology. In such a roll of honor he would undoubtedly himself inscribe the names of Matthew, Granger, Brown, Lull, Forster-Cooper, Andrews, Frick. And among the younger men of to-day are several to whom he was happy to entrust the future of paleontology.

As a student of Huxley and a disciple of Darwin, Osborn developed a broad interest in many branches of the biological sciences, as shown in his general work "The Origin and Evolution of Life"; but his most intensive work was in the field of mammalian paleontology. His first important memoir was a systematic revision and study of the fossil teeth and jaws of the tiny mammals which were the contemporaries of the dinosaurs. Quite early (1888) began his interest in the evolution of mammalian molar teeth. Cope had already supplied the first key to the interpretation of the origin of the complex folds on the surface of the crowns of the molar teeth of herbivorous mammals. Osborn very successfully used this "tritubercular key," as he called it, to decipher the historical stages in the evolution of the molar teeth in the families of the horses, rhinoceroses, titanotheres, tapirs and many others. Even at the present time, making all due allowances for later discoveries and corrections, this Cope-Osborn theory is widely and usefully applied by many paleontologists.

In his later years Osborn undertook to prepare a series of great monographs on the histories of the families of horses, titanotheres and proboscideans or mastodonts and elephants. In view of the heavy demands on his time from many other directions, his achievements in this field were truly enormous. The monograph on the titanotheres, numbering 953 large quarto pages, 797 text figures and 236 plates, was published in 1929. The great two-volume monograph on the Proboscidea was not completed until long after his death, the second volume having been published last month. But apart from one signed chapter on the geology of the Proboscidea, which is contributed by Dr. Colbert, one of Professor Osborn's former assistants, all the essential parts of this monograph are exclusively his own and they have been assembled and edited according to his own plan by his former secretary, Miss Mabel R. Percy.

These two great works stand out among the 940-odd entries in his bibliography and will be consulted as long as paleontology remains a living science. In spite of the vast complexity of the family tree of the proboscidea and of the many gaps that still remain in the record, this monograph presents cumulative evidence that the molar teeth, tusks and other parts of the ancestral elephants have become modified in the various ways described by Osborn. But those who prefer to ignore or to ridicule such evidence for the reality of evolution as an historical process will doubtless continue to rely upon their dialectic skill and strive to prove that evolution is not a fact because it is impossible.

Osborn's greatness as a scientist depended upon his greatness as a man. His vision, enthusiasm, convic-

[1] Addresses at the unveiling of the bust of Professor Osborn, April 8, 1942.

tion, persistence, persuasiveness, tolerance and restraint made him successful both as leader and investigator. Indeed those of us who were close to him as a scientist immediately felt and responded to his benign influence as a man.

The portrait in bronze by Joy Flinsch Buba, which will presently be unveiled, while almost Olympian in its impression, will bring us face to face with Osborn the scientist, philosopher and friend, as we knew him in his later years. But this vital record in bronze may also suggest to us the young Osborn, fresh from his contact with Darwin and Huxley, and already inspired with the first vision of evolution, which culminated in his monograph on the Proboscidea.

William K. Gregory
American Museum of Natural History

The contribution which men make to the advancement of a civilization can never be accurately assessed and least of all by contemporaries who inevitably tend to exaggerate the importance of existing conditions which often prove ephemeral. Moreover, the seed which men sow frequently flowers long afterward and is consequently overlooked during their lifetime and immediately thereafter. Furthermore, acts, ideas, convictions which may elicit current criticism and disparagement not infrequently prove later to have been abundantly justified. Both for what they do and for what they fail to do, men are often misjudged and the near view of them is by no means to be regarded as entirely reliable.

The man whose memory we are gathered to honor to-day is, fortunately, immune to any serious peril of lack of appreciation, although only time will approximate a just evaluation of his accomplishments. His greatest contributions live on in this great institution which he served so long and so brilliantly. As himself an eminent scientist, constantly contributing to push forward the boundaries of knowledge, by his example inspiring the members of his staff and scientists everywhere to similar achievements, not less than by his administrative ability and his talent for interesting generous benefactors in the support of this enterprise, he left an indelible imprint upon his time. He put this museum into the very forefront of the great scientific agencies of the period, stimulating throughout the nation a new understanding of the educational power of such institutions, while serving this great metropolitan community by opening ever wider to its citizens the unrivaled wealth of its superb collections. In all this undertaking he worked side by side with his loyal colleagues in the organization—*primus inter pares.*

He was deeply enamored of the term "creative" and of the idea behind it. In a sense every voluntary act that anyone performs is creative. It initiates changes in previously existing conditions, even as it was itself brought into being by preceding acts and events. Such a conception of creation is true, but it is sterile so far as concerns the situations in which Osborn was primarily interested. It is the notion of the creative which is discovered in the work of the artist, or the explorer and the research worker which embodies the ideals that Osborn had in mind and whose worth seemed to him supreme in the world of mind. The clearly formed purpose, the definitely articulated objective, the carefully planned method of attack, the tireless and ingenious pursuit of the end sought, the untiring and courageous tenacity which can not be discouraged or disheartened—these are among the important qualities which enter into the creative thinking and conduct that kindled Osborn's enthusiasm and enlisted his support.

In the work of the artist there may appear to be more of the purely spontaneous than in that of the scientific research worker, yet the greatest works of art all reveal deep underlying purposes, involving the most careful planning, and an enormous investment of tedious labor in their realization. The Parthenon, the Dome of St. Peters, Giotti's Tower, Raphael's Transfiguration, Milton's "Paradise Lost," Dante's "Divine Comedy"—one can extend the list indefinitely—are all adventures of the human spirit in the creation of enduring values into whose production have entered many of the most precious gifts of sheer intelligence.

But Osborn's interest in creative thinking was naturally not confined to the initial process of planning, nor to the merely conscientious and laborious search for new facts. It inevitably included the effort to enlarge the horizons of recognized truth, to set new discoveries in effective relation to established knowledge, to formulate fresh and broader principles, more revealing correlations than those which had previously been understood or accepted.

In this process his own work came at times under severe attack, for while the well-authenticated fact is reasonably immune to assault, the inferences based upon it, the generalizations arising out of the effort to orient it amid other data and principles, unavoidably lead to corrective interpretation at other hands. The man of sincere scientific spirit is never seriously irked by this experience, provided he be not essentially misrepresented, for much of this kind of rough and tumble is inevitable in all progress. Osborn certainly had his full share of this type of conflict and would unquestionably accept with good grace such corrections and modifications of his own views as with the passing of the years the development of scientific knowledge may involve. Nor does it follow that be-

cause his own particular views may in certain cases fail to prevail, his contribution is in any way to be held lightly. Quite the contrary is the fact. Such approximation to truth as the human mind can ever attain is always the result of the clarifying increments made by successive generations of thoughtful men.

Men possessing such a combination of qualities as those of Henry Fairfield Osborn are all too rare. The good administrator is a familiar figure, the eminent scientist has many exemplars, even the scientist of deeply religious convictions, such as Osborn held, is by no means unknown; but it is *extremely rare* to find these gifts combined in one man, and when they are conjoined with a remarkable charm of personality and sterling integrity of character, we are confronted with one of the most unusual of the benefactions of a generous Providence.

Such a man was he in whose honor we have assembled in this place he loved. A distinguished scientist, a faithful friend, a great citizen—his memory will be kept ever green as long as this institution endures.

JAMES R. ANGELL
THE NATIONAL BROADCASTING COMPANY

OBITUARY

RAYMOND DODGE

RAYMOND DODGE, A.B., Williams, 1893; Ph.D., Halle, 1896; honorary Sc.D., Williams, 1918; emeritus professor in Yale University, died on April 8 at the age of 71 years. He was born in Woburn, Massachusetts, in 1871.

In the death of Professor Dodge, American psychology has lost one of its most stalwart pioneers. Few of his contemporaries have made so fundamental contributions and had so little occasion to recant. Endowed with a fertile imagination, practical ingenuity, far-sighted perseverance and a critical and philosophical bent of mind, he became a bold and rigorous experimenter in the development of psychological techniques and in the implementation of his findings both in theory and widely varied applications. He was a level-headed and inspiring person. Young psychologists might well find in him a model of an upright scientist.

We note six distinct epochs in his career: his formative period in philosophy at Williams; his association with Benno Erdmann in Halle; the 26 years of teaching and research at Wesleyan University, Connecticut; the association with Benedict in research on nutrition in the Carnegie Institution of Nutrition; the war episode; and the professorship at Yale.

After a year of graduate work at Williams he went to Germany to continue his studies in philosophy. He there set up a life-long and intimate association with Professor Erdmann, took his doctorate under him and became his assistant and collaborator in extensive researches and publications in the field of experimental psychology of reading which he long regarded as his specific field of investigation, particularly the field of eye movements. For this he built the Erdmann-Dodge tachistoscope, the Dodge mirror tachistoscope and an apparatus for the photographing of eye movements. With each of these instruments he found scores of applications. He was the first to measure and classify eye movements and to utilize that technique in pure psychology, education, physiology, pharmacology, psychiatry and war.

In 1909–1910 he had sabbatical leave and spent one semester in the Marey Institute in Paris and another in Göttingen with the physiologist, Max Verworn. Here he also became closely associated with G. E. Müller in psycho-physics. In 1916–1918 he took leave of absence from Wesleyan and spent two years in research in Columbia University having to do mainly with neurophysiological characteristics of human variability. Later he spent one year in the nutrition laboratory of the Carnegie Institution studying the psychomotor effects of light doses of alcohol.

With the coming of the war he entered war services with extraordinary vigor. In the Navy service he invented an instrumental device for the selection and training of gunners which has had wide and effective use. Of his activities in World War I he writes in his autobiography:

> My second excursion into the applied field was during the Great War. It really amounted to a concentration of my entire scientific experience into a few months of agonizing exploitation. Probably no one else on the Psychological Committee except the chairman had the privilege of participating in so many phases of war service. I was a member of the original planning committee formed at the spring meeting of Experimentalists at Harvard, of the Psychology Committee of the National Research Council, of the Committee on Fatigue of the National Committee of Defense, and of the Committee on the Classification of Personnel in the Army. I was chairman of the Committee on Vision and of the Committee on Psychological Instruction of the Psychology Committee, Psychological Consultant of the Training Section of the Bureau of Navigation of the Navy for the selection of listeners, and, at the end of the war, responsible for the psychological side of the Lookout School at New London as Lieutenant Commander, U.S.N.R.F. Naturally I was not equally effective in all these enterprises, but all were, I think, reasonably successful. I was glad of all the opportunities for national service but especially glad to be in the anti-submarine warfare which aroused me more

than any other phase of the war. One of the great moments of my life was when, after months of work as consultant, I found myself an officer of the U.S.N.R.F. for scientific service. I have a suspicion that my appointment transgressed many Naval traditions.[1]

Dodge carried heavy editorial responsibilities: Editor, *Psychological Bulletin*, 1904–1910; *Psychological Review*, 1910–1915; *Journal of Experimental Psychology*, 1916–1920; *Psychological Monographs*, 1927–1931; associate editor of *Journal of Comparative Psychology*, *Psycho-Biology* and *Journal of General Psychology*.

He had many responsibilities in learned societies, notably, the National Academy of Sciences, the National Research Council, chairman of the division of anthropology and psychology in 1922–1923, and American Psychological Association, president, 1916–1917.

His bibliography up to 1931 is published in the Psychological Register.[2] His autobiography appears in Volume I of the "History of Psychology in Autobiography."

In 1924 he went to Yale and associated himself with the psychological triumvirate—Dodge, Yerkes and Miles in the Institute of Human Relations, from which he retired in 1936.

CARL E. SEASHORE

RECENT DEATHS

DR. JOSEPH CHARLES ARTHUR, since 1915 emeritus professor of botany at Purdue University, died on April 30 at the age of ninety-two years.

DR. JOHN H. SKINNER, professor of animal husbandry and dean emeritus of the School of Agriculture of Purdue University, died on April 28 at the age of sixty-eight years.

SCIENTIFIC EVENTS

THE MARINE BIOLOGICAL STATION AT PORT ERIN

ACCORDING to the report of the acting director of the Marine Biological Station at Port Erin, work during 1941 was again determined by the continuance of war conditions. Visits by student classes have been rendered all but impossible by the ban on residence within the Port Erin Internment Camp of any but the permanent population of the village. Nevertheless, a number of postgraduate workers and one school class have been able to make use of the station's facilities, under police permit, while occupying rooms outside the camp area—a course recommended to other prospective workers. The closure of Port Erin to summer visitors has reduced the income from the aquarium to negligible proportions, so that this side of the work is being kept at care-and-maintenance level. Endeavor has been made, by cooperation with the Army Educational Scheme and in other ways, to render service to the members of H.M. Forces now in the island. There have been several organized visits by parties of soldiers, and the acting director has given numerous illustrated lectures, on marine and other topics, at two military centers. On the scientific side, the work of both staff and visiting research workers has been closely aligned with that of certain official and quasi-official investigations into (a) the reproduction and growth-rate of certain seaweeds of industrial importance, with a view to their rational harvesting, and (b) the further development, under war conditions, of the fishing potentiality of Manx waters.

More time than usual has this year been devoted to the library; a considerable overhaul has taken place, arrears of binding made good and an entirely new shelf-catalogue and an accessions register prepared. With the help of one or two assistants with experience in library work, the collection of separata on marine biological and hydrographical subjects, numbering several thousand papers, has been entirely reorganized.

In view of the continued deprivation of income from the public aquarium and from fee-paying students, the departmental grant of the university to the station, for the session 1941–42, has been increased from £150 to £200. A renewal for the same session of the grant-in-aid from H.M. Development Commission of £100 is also acknowledged.

STANDARDS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

THE Executive Committee of the American Society for Testing Materials has recognized the desirability of providing for prompt modification of standards during the national emergency and that some appropriate method be established in anticipation of necessary changes, particularly in specification requirements, due to possible rapid shifts in the available supply of materials under present conditions.

The procedure planned, as given in the *Bulletin* of the society, provides that

> in the case of certain metals and alloying elements, for instance, scarcity and the need of conservation for defense purposes might point to the need of modifying the usual

[1] C. Murchison (Ed.), "History of Psychology in Autobiography," Vol. I, 1930, 99–121. Worcester, Mass.: Clark University Press.

[2] C. Murchison (Ed.), "The Psychological Register," Vol. III, 1932, 133–134. Worcester, Mass.: Clark University Press.

specified compositions of many alloys containing such critical materials, and of doing so more promptly than the regular procedure would permit. In fact, in most instances it will probably be found preferable not to change the standard itself but to provide for temporary optional requirements. Our regular procedure provides that a standing committee, after approval in its group, can refer to any time proposed tentative revisions of standards, new tentative standards or changes in tentative standards to Committee E-10 on Standards. While in this way reasonably prompt action can be taken with respect to desirable changes leading to formal revisions of a standard, a proposed emergency procedure is now offered our committees which is intended to expedite the approval and publication of emergency revisions of a temporary nature and at the same time provide adequate safeguards in their promulgation.

Revisions promulgated under this procedure are to be construed as representing optional requirements, to be introduced by the following expression: "Where it may be considered by the purchaser a satisfactory revision for the specific application or use desired."

Proposed temporary modifications shall first have the approval of the appropriate subcommittee of the sponsoring committee or duly appointed subgroup of that subcommittee and shall have the endorsement of the chairman of the main committee. The emergency revision shall then be submitted to Committee E-10 for approval for publication with the specification in question. If approved by Committee E-10, it will be published with the specification either in the form of a sticker or as an accompanying sheet and will also be published in the next succeeding issue of the *Bulletin*. Any emergency revisions approved during the year will be recorded in the next annual report of the standing committee. All such revisions will be subject to annual review and the standing committee shall annually report its recommendations with respect to them.

GIFTS AND BEQUESTS TO CORNELL UNIVERSITY FOR 1941

GIFTS and bequests to Cornell University during the fiscal year ending July 1, 1941, amounted to $2,-261,037, according to the annual report of treasurer, G. F. Rogalsky. Of this amount $1,054,330 was added to the university's permanent endowment, which is now $33,871,539.

Gifts for current use included $384,024 for research and investigatorships, $100,000 toward an addition to the physical plant, $31,138 for departmental development, $26,736 for scholarships and loans and $119,604 for miscellaneous purposes. The balance is composed of non-endowment funds, of which some are specifically restricted as to use and others expendable at the discretion of the Board of Trustees.

The total includes $112,902 in current gifts from 7,220 alumni through the Alumni Fund Council, a record, both for amount contributed and number of contributors, unsurpassed since 1931. Cornell alumni also gave $37,-903 during the year toward the university's program for developing athletic facilities.

The largest bequest, $508,573, came from the estate James Parmalee, Cleveland real estate operator financier, who was graduated from Cornell in 18 Gifts from the Rockefeller Foundation for endowm research and departmental development totalled $697,4 Of this sum, $600,000 was to endow the Department Public Health and Preventive Medicine in the Corn University Medical College in New York. The foundati also made grants for research in tuberculosis, ami acids, longevity, reflex behavior, maize stock, chemistr physics and the history of the Far East, and for de partmental development in public health, anatomy, dram music and Russian language and literature. An add tional $5,555 was received from the General Educati Board for a project in critical thinking.

S. C. Johnson and Son, Inc., gave $56,500 toward th establishment of the Herbert Fisk Johnson professorsh in industrial chemistry, and the Olin Foundation contrib uted $100,000 toward the development program of th School of Chemical Engineering.

Among the notable bequests received during the year were additions amounting to $76,280 to the John McMulle Fund for scholarships in engineering, bringing the total of this fund to more than $2,000,000; $49,644 and an art col lection valued at $35,000 from the estate of Roger P Clark, an alumnus of the university; $32,380 of an an ticipated $100,000 from the estate of John A. Heim, graduate of the Medical College in 1905, to be used for scholarships in the Medical College, and $31,392 from th estate of L. L. Seaman, $25,000 from the estate of Henr R. Ickelheimer, $21,678 from the estate of Mary Kersch ner, $19,030 from the estate of Rollie B. Low, $13,82 from the estate of Mabel Estey Rose, $11,600 from th estate of Della S. Bishop and $10,000 from the estate of S. Wiley Wakeman.

Among the numerous grants for research were fund of $21,950 from the Josiah Macy, Jr., Foundation for research in neurology, pneumonia, senility, biotin, avia tion and family health; $15,012 from the National Re search Council for studies of student pilots, morphology metabolism, visual fatigue, physiology, air-sickness, night blindness and other phases of medicine as applied to aviation, and $9,101 from the GLF Exchange for studies in freezing foods, dairy feed, poultry, phosphate, cereal breeding and legume inoculant.

Anonymous contributions of $18,000 and $20,000 and the sum of $10,000 from Stanton Griffis, a graduate in 1910 and a university trustee, were received to be added to endowment funds. The sum of $10,000 was received from the Ralph Hitz Memorial Fund to establish a scholarship in hotel administration.

THE NASHVILLE MEETING OF THE ELECTROCHEMICAL SOCIETY

AT the annual meeting of the Electrochemical Society, which was held at Nashville from April 15 to 18, two symposia were presented—one on "Electric Furnace Reactions," in charge of Dr. John D. Sullivan, of the Battelle Institute, Columbus, and the other

"Corrosion," in charge of Dr. R. M. Burns, of the Bell Telephone Laboratories, New York City. In addition to technical papers presented at the various sections, one morning session was devoted to "Electrochemical Research."

At the banquet on Thursday, President Raymond R. Ridgway spoke on "Crystal Gazing with War Time Illumination." The award of the Weston fellowship to William E. Roake was announced at the dinner. Mr. Roake will work on the glass electrode under Professor Malcolm Dole at Northwestern University. There was also announced the award of the "Young Authors" prize to Dr. Edward Adler, of the College of the City of New York, who recently received the doctorate of philosophy at Columbia University, for two papers that were presented at the Cleveland convention a year ago on "Photovoltaic Effect" and "Semi-Conductor Photocells and Rectifiers."

Officers of the society elected for the coming year are: *President,* E. M. Baker, University of Michigan; *Vice-presidents,* R. B. Mears, Aluminum Company of America, New Kensington, Pa.; J. A. Lee, *Chemical and Metallurgical Engineering,* New York City; and C. L. Mantell, United Merchants and Manufacturers' Management Corporation, New York City. Dr. Colin G. Fink, of Columbia University, is secretary of the society.

The next meeting will be held in Detroit from October 7 to 10.

THE NATIONAL ACADEMY OF SCIENCES

THE National Academy of Sciences held its regular annual meeting at Washington in the building of the academy and the National Research Council on April 27 and 28.

The meeting was devoted entirely to matters concerning the present work of the academy, consideration of possible changes in its structure and operation, and with the election of officers and new members. There were no sessions for the presentation of scientific papers and no social functions, except a smoker for members on Monday evening.

Officers and new members of the academy were elected as follows:

Foreign Secretary (to succeed L. J. Henderson, deceased): Walter B. Cannon, Harvard Medical School.
Members of the Council: A. N. Richards to succeed himself; G. W. Corner to succeed C. A. Kraus.
Foreign associate: Robert K. S. Lim, Peiping Union Medical College.
Members of the academy:

Homer Burton Adkins, University of Wisconsin.
Lyman James Briggs, National Bureau of Standards.
Hans Thacher Clarke, Columbia University.
Ralph Erskine Cleland, Indiana University.
Charles Haskell Danforth, Stanford University.
Albert Einstein, Princeton, N. J., foreign associate of the academy since 1922.
Conrad Arnold Elvehjem, University of Wisconsin.
Michael Heidelberger, Columbia University.
John Gamble Kirkwood, Cornell University.
Paul Dyer Merica, 67 Wall Street, New York, N. Y.
Thomas Midgley, Jr., Worthington, Ohio.
Francis Dominic Murnaghan, the Johns Hopkins University.
John Torrence Tate, University of Minnesota.
Alfred Marston Tozzer, Harvard University.
Ernest Edward Tyzzer, Harvard Medical School.
Selman Abraham Waksman, Agricultural Experiment Station, New Brunswick.

SCIENTIFIC NOTES AND NEWS

THE Herty Medal of the department of chemistry of the Georgia State College for Women at Milledgeville has been awarded to Dr. Townes R. Leigh, dean of the College of Arts and Sciences of the University of Florida, in recognition of "distinguished services as a teacher and of his research in plants and soil." At the presentation of the medal Dr. Leigh will make an address, entitled "The Spirit of Science."

DR. RUDOLPH MATAS, professor of general and chemical surgery emeritus at the Tulane University of Louisiana, has been presented with the Medal of Havana, the highest distinction conferred by that city, in commemoration of the anniversary of the birth of Dr. Carlos I. Finlay, of Havana, Cuba.

AT a recent meeting of the Cleveland Medical Library Association a portrait of Dr. William E. Bruner, professor emeritus of ophthalmology at Western Reserve University, was presented to the association, and an alcove in the library was named for him.

FORMER students of Professor Arthur S. Watts, chairman of the department of ceramic engineering of the Ohio State University, honored him at the Ohio State Ceramic Alumni dinner in Cincinnati on April 22. At the dinner, which is held each year during the annual meeting of the American Ceramic Society, the establishment of the Arthur S. Watts Fund was announced. This fund, for which $1,400 has so far been received, will when completed be used as a scholarship or loan fund for students in the department of ceramic engineering at the Ohio State. Professor Watts was presented with a book containing letters of greetings, congratulations and appreciation from more than two hundred of his former students.

AMONG the recipients of honorary degrees conferred

on April 26 at the graduation ceremonies of the University of Pittsburgh were Forest A. Foraker, professor of mathematics since 1912, and J. LeRoy Kay, curator of paleontology at the Carnegie Museum.

Dr. Paul D. White, physician at the Massachusetts General Hospital, Boston, was elected president of the American Heart Association at the recent New York meeting.

Officers of the Grinnell Naturalists Society elected at the annual meeting held at the University of California on April 11 are: *President,* Seth B. Benson, Museum of Vertebrate Zoology, University of California; *First Vice-president,* Robert T. Orr, California Academy of Sciences; *Second Vice-president,* D. F. Tillotson, California Division of Fish and Game; *Recording Secretary,* D. F. Hoffmeister, University of California; *Corresponding Secretary,* Thomas L. Rodgers, University of California; *Treasurer,* Frank A. Pitelka, University of California; *Council Members* (two-year term), C. A. Reed and John Davis, University of California.

Members of the faculty of Columbia University who will retire this year include Dr. Robert S. Woodworth, professor of psychology; Dr. James H. McGregor, professor of zoology; Dr. W. Benjamin Fite, Davies professor of mathematics; Dr. Horatio B. Williams, Dalton professor of physiology; and Dr. Ernest L. Scott, associate professor of physiology.

Dr. J. B. S. Norton, professor of plant pathology at the University of Maryland, a member of the faculty since 1901, plant pathologist and botanist at the Experiment Station, retired from active duty on April 1. He has been appointed professor emeritus and will continue his work in plant breeding and taxonomy and on the botanical herbarium of the university.

Dr. Samuel H. Maron, of the Case School of Applied Science at Cleveland, has been promoted to an associate professorship of physical chemistry.

Dr. Royse P. Murphy, assistant professor of plant breeding and assistant in agronomy and plant genetics at the University of Minnesota and at the Experiment Station, has been appointed associate professor of agronomy and associate agronomist at Montana College and Station. He takes the place of Dr. A. M. Schlehuber, who resigned recently.

Dr. F. R. Immer, acting vice-director of the Experiment Station of the University of Minnesota, has been made vice-director. He will continue his work as professor of agronomy and plant genetics.

Dr. John S. Karling, professor of mycology at Columbia University, has been granted a Bermuda biological fellowship for the study of chytrid parasites of marine algae.

Dr. Noe Higinbotham has been appointed plant physiologist to conduct investigations with rice at the Beaumont Substation of the Texas Agricultural Experiment Station during the absence of Lieutenant C. E. Minarik. Dr. Higinbotham held a Seessel research fellowship in botany at Yale University during the past year.

Dr. Frank J. Tone, since 1895 president of the Carborundum Company, Niagara Falls, has retired from the presidency and has been elected to the newly established position of chairman of the board of directors.

Dr. L. W. Bass, of the Mellon Institute of the University of Pittsburgh, has been appointed director of the New England Industrial Research Foundation, Inc. He will engage in a systematic study of the manufactures and industrial problems of the New England States. Special emphasis will be placed on wartime requirements and on the furnishing of technical information to small and medium-sized companies.

Dr. Frank P. Cullinan, senior pomologist in the division of horticultural crops and diseases of the Bureau of Plant Industry, U. S. Department of Agriculture, has been appointed assistant chief of the bureau.

H. W. Straley, III, head of the department of geology at Baylor University, Waco, Texas, has resigned. At the end of the spring quarter he will become connected with the Eastern Exploration Company in the Appalachian and Interior oil and coal fields.

Dr. George William Hunter, III, assistant professor of biology at Wesleyan University, has received a captain's commission in the Sanitary Corps, Medical Department of the Army. He is now stationed at the Army Medical School, Washington.

Dr. J. S. Potter, staff member of the department of genetics of the Carnegie Institution of Washington, Cold Spring Harbor, N. Y., has been commissioned a captain in the Army of the United States. He reported on May 5 at headquarters of the Army Air Forces in Washington. Dr. Potter has been granted leave of absence from the Carnegie Institution for the duration of the war.

Dr. Harry B. Feldman, of the Worcester Polytechnic Institute, is serving as captain in the Chemical Warfare Service at Edgewood Arsenal, Md.

Members of the National Patent Planning Commission set up by President Roosevelt are Charles F.

Kettering, *chairman,* Owen D. Young, Chester C. Davis, Edward F. McGrady and Frances P. Gaines.

A SPECIAL committee "to appraise the work of the American Standards Association and to propose a program of development and financing" was authorized at a meeting on December 10, 1941, of the board of directors. Members of the committee have now been appointed as follows: R. E. Zimmerman, president of the American Standards Association, *chairman;* S. Bruce Black, National Association of Mutual Casualty Companies; George S. Case, American Society of Mechanical Engineers; C. L. Collens, National Electrical Manufacturers Association; Howard Coonley, Manufacturers Standardization Society of the Valve and Fittings Industry; H. S. Osborne, of the Telephone Group of the association and *chairman* of the Standards Council; J. C. Parker, vice-president, Consolidated Edison Company, until recently a member of the board of directors and of the council of the association.

THE annual Mellon lecture of the Society for Biologic Research of the School of Medicine of the University of Pittsburgh was delivered on April 23 by Dr. Herbert M. Evans, Morris Herzstein professor of biology and director of the Institute of Experimental Biology of the Medical School of the University of California. He spoke on "Unsolved Problems in Anterior Pituitary Physiology."

DR. E. D. ADRIAN, F.R.S., professor of physiology at Cambridge, is giving a series of lectures under the auspices of the British Council in Buenos Aires.

THE Linacre Lecture of the University of Cambridge was delivered on May 6 by Sir Joseph Barcroft, emeritus professor of physiology. He spoke on "The Onset of Respiration at Birth."

A MEETING of the Optical Society of America will be held at the Massachusetts Institute of Technology, Cambridge, on July 20, 21 and 22. A special feature of this meeting will be a symposium of invited papers on fluorescence and phosphorescence. Sessions will also be held for the reading of contributed papers.

THE tenth annual Summer Conference on Spectroscopy and Its Applications, sponsored jointly by the Optical Society and the Massachusetts Institute of Technology, will also meet from July 20 to 22. Admittance will be by reservation as usual. Further information and tickets to the conference can be obtained from Professor George R. Harrison, Massachusetts Institute of Technology, Cambridge. Arrangements have been made to include the program of the Conference on Spectroscopy in the program that will be issued early in July for all members of the Optical Society.

THE American Association of the History of Medicine held its eighteenth annual meeting at Atlantic City on May 3, 4 and 5. The address of the president, Dr. Jabez H. Elliott, of Toronto, was entitled "Observation and Interpretation." Dr. Hugh H. Young, of the Johns Hopkins Medical School, gave an address entitled "Crawford W. Long: the Pioneer in Ether Anesthesia," in commemoration of the one hundredth anniversary of the first application of ether anesthesia.

DISCUSSION

THE METHOD OF CONGRESSIONAL APPORTIONMENT UNDER THE LAW OF 1941

PUBLIC LAW 291 (H.R. 2665), signed by the President on November 15, 1941, directs that future apportionments of representatives in Congress shall be made by the method of equal proportions.

This method, devised in 1921, sets up the following criterion of a good apportionment. Suppose an actual apportionment bill, allotting any given number of seats (say 435) among the several states, is before Congress for consideration; and suppose an attempt is made to improve the bill by transferring a seat from one state to some other state. *Such proposed transfer of a seat from one state to another state should be made if, and only if, the percentage difference between the congressional districts in these two states would be reduced by the transfer.*

For example, Arkansas has a 1940 population of 1,949,387, and Michigan 5,256,106. Under the method of equal proportions, Arkansas gets 7 seats and Michigan gets 17 seats, so that Michigan's district (309,183) is 11.02 per cent. larger than Arkansas's district (278,484). But if a seat were transferred from Arkansas to Michigan, giving Arkansas 6 and Michigan 18, the Arkansas district (324,898) would be 11.26 per cent. larger than the Michigan district (292,006). Since 11.26 is greater than 11.02, the transfer should not be made.

By following a short-cut process of computation, the Bureau of the Census prepares, after each decennial census, an apportionment table which is certain to satisfy the above test for every pair of states. But any dispute between two states can be settled immediately by a direct application of the test, the only data required being the populations of the two states directly concerned and the number of seats allotted to each.

An extensive Bibliography on Methods of Appor-

tionment may be found in the *American Mathematical Monthly*, vol. 49, p. 115, February, 1942.

For the convenience of any one who may wish to reproduce the "short-cut process of computation" we append the working rule actually followed in the Bureau of the Census.

Given, the populations of the several states. *First,* assign one seat to each state (here 48 in number). *Second,* multiply the population of each state by a series of multipliers given in Table 1. The number of multipliers used for each state should be somewhat greater than the number of seats expected to be assigned to that state.

TABLE 1

MULTIPLIERS FOR THE METHOD OF EQUAL PROPORTIONS

k	Multiplier	k	Multiplier
		27	.0377 4257
2	.7071 0678	28	.0363 6965–
3	.4082 4829	29	.0350 9312
4	.2886 7513	30	.0339 0318
5	.2236 0680	31	.0327 9129
6	.1825 7419	32	.0317 5003
7	.1543 0335–	33	.0307 7287
8	.1336 3062	34	.0298 5407
9	.1178 5113	35	.0289 8855+
10	.1054 0926	36	.0281 7181
11	.0953 4626	37	.0273 9983
12	.0870 3883	38	.0266 6904
13	.0800 6408	39	.0259 7622
14	.0741 2493	40	.0253 1848
15	.0690 0656	41	.0246 9324
16	.0645 4972	42	.0240 9813
17	.0606 3391	43	.0235 3104
18	.0571 6620	44	.0229 9002
19	.0540 7381	45	.0224 7333
20	.0512 9892	46	.0219 7935–
21	.0487 9500	47	.0215 0662
22	.0465 2421	48	.0210 5380
23	.0444 5542	49	.0206 1965+
24	.0425 6283	50	.0202 0305+
25	.0408 2483	51	.0198 0295+
26	.0392 2323	52	.0194 1839

(In this table, $M = 1/\sqrt{[(k-1)k]}$; the entries may be verified by squaring, without extracting any square roots.) *Third,* arrange all the resulting products in a single list in order of size, beginning with the largest. This forms a "priority list," indicating the order in which seats (in excess of 48) shall be given out. *Fourth,* assign seats to the several states in the order thus indicated, until any desired total (say 435) has been reached.

As noted above, any dispute between two states can be settled without any knowledge of the technical process of computation, by direct application of the test.

EDWARD V. HUNTINGTON

HARVARD UNIVERSITY

SOME OBSERVATIONS ON THE FEEDING HABITS OF THE OCTOPUS[1]

IN recent years much has been written pertaining to the feeding habits of marine animals and of the minute details of the mechanisms involved in the capture and ingestion of their food. These studies result from an appreciation of the fact that the fundamental relationship among different species of a community of animals is a nutritional one, and in order to better understand the ecological implications, it is essential to know how the animals as individuals are able to capture their food or to escape the enemies preying upon them. The type of food utilized in any specific case is determined (sometimes within narrow limits) by the type of feeding mechanism possessed by the organism. Animals capable of active locomotion must seek out biotopes which support their food and the density of the organisms preyed upon will be determined in large measure by the efficiency of the catching apparatus of the predator, which is thus a factor in the balance of nature.

A common method of capturing food is by means of netting or screening devices such as the fine bristles on the appendages of barnacles, copepods, etc., or the gill rakers of fishes or whalebone of baleen whales. These netting devices, owing to their sieve-like nature, function to *concentrate* finely divided and scattered planktonic food gathered from a large quantity of water. A study of the feeding habits of the octopus reveals an ensnaring device of quite different nature, since, though it functions to make a multiple catch, it is not designed to filter but rather to impound.

The commonly observed method of gathering food by the octopus is that of lying in wait or stealthily approaching and suddenly striking out at its prey with a tentacle and grasping it with the aid of the suckers. But in addition to this method, small prey such as shrimp and small fish which live among low-growing seaweeds on the bottom, and which possess great agility in escaping the predator, may be caught in larger numbers by throwing over them a canopy-like web formed by the loose extensible membranes of skin connecting the bases of the tentacles and extending for some distance along the sides of each. This method of feeding was observed in the field on several occasions for large specimens of *Paroctopus apollyon* near the University of Washington Oceanographic Laboratories at Friday Harbor, Washington, and in view of the apparent want of published records of similar observations, it is deemed worth a brief note at this time.

The fishing action consists essentially of four steps: (1) gliding stealthily forward over seaweed beds while three or more tentacles are extended forward and high off the bottom; (2) the upraised tentacles are then slowly arched, bringing the distal ends downward with almost imperceptible movement to the bottom where the end suckers presumably attach to the hard bottom; (3) when this has been accomplished the loose web

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 163.

of the tentacles is extended with incredible speed so that the membranes of skin between adjacent tentacles form a closed canopy or "net" under which the shrimp and fish lurking in the sea weeds are impounded; (4) now the canopy is gradually diminished in size by pressing the tentacles closer to the ground in such a manner that the catch is slowly forced inward towards the mouth. The whole process is then repeated, sometimes in quite rapid succession. One specimen kept under observation from a rowboat made fifteen "hauls" in twenty minutes. The method is sometimes modified somewhat to a more commonly observed one whereby the animal pounces forward upon the prey with a less extended canopy.

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SCRIPPS INSTITUTION OF OCEANOGRAPHY,
LA JOLLA, CALIF.

INFECTIVITY OF EXTRACTED, UNPRESERVED TOBACCO MOSAIC VIRUS RETAINED 28 YEARS

THE extracted, unpreserved virus of mosaic-diseased tobacco may retain its infectivity for a long period of time *in vitro* under certain conditions.

On February 27, 1914, I set aside a portion of the original extracted virus of tobacco mosaic with which I was working at this time. This virus was used for studies upon which early papers were based, including, among others, "The Mosaic Disease of Tobacco"[1] and "Effects of Chemicals on the Virus of Mosaic Disease."[2]

A portion of the original virus, merely filtered through filter paper, was placed in a vial, tightly stoppered with cork, and kept on a shelf at room temperature since 1914.

This virus, tested in 1936, was found to be as infectious as when first extracted. It was again tested in 1942, by inoculating twenty small Connecticut Broadleaf plants, using the method of rubbing the virus on the glandular trichomes of the leaves on February 27. The first symptoms of mosaic were indicated on March 7 on nine plants, and the remaining eleven plants showed symptoms on March 9. Control plants had shown no symptoms several weeks later.

The pH of this original virus was determined at the time of testing in 1942 with a Beckman pH meter, using a glass electrode, and was found to be 6.76 or near neutral. These tests indicate clearly that this virus, although stored without preservatives at room temperature, was highly infectious 28 years later.

In "A Textbook of Plant Virus Diseases," by Kenneth M. Smith, 1937 (p. 232), it is stated that sterile, filtered juice retains its infectivity probably several years, but that ordinary extracted sap stored at room temperature soon becomes reduced in strength. The latter statement appears to be based upon the paper "Accuracy in Quantitative Work with Tobacco Mosaic Virus," by F. O. Holmes.[3] Holmes found a rapid reduction in number of infections in aging, undiluted and unpreserved virus stored at room temperature. His results would indicate a partial breakdown or denaturing of the infective principle, whereas this has been slight in the case of my 28-year-old virus.

Long ago I found that the degree of infectivity of such extracted, unpreserved virus would quickly decline, even to the point of becoming entirely innocuous, or the virus might remain highly infectious for years. In general, two types of fermentation appeared to occur, one resulting in acid conditions apparently very destructive to the virus, accompanied by a sour or acid and not unpleasant odor; the other with a near neutral reaction or low acidity condition favoring retained virulence, characterized by a most persistent and offensive odor.

Dried and ground leaf material obtained from mosaic-diseased tobacco on November 9, 1915, and stored in a jar at room temperature was no longer infectious in 1936.

These tests would indicate that the retention of virulence of extracted, unpreserved sap depends upon the type of fermentation which gains control under certain conditions.

H. A. ALLARD
BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

[1] *Bull.* 40, U. S. D. A., 1914.
[2] *Jour. Agric. Res.*, 13, 1918.
[3] *Bot. Gaz.*, 86: 66–81, 1928.

WEATHER FORECASTS

AMONG the *Science News* "Items" in SCIENCE for December 26, the one on weather forecasts gives a quaint little pat on the back to one of the most persistent and wide-spread of popular misconceptions about our atmosphere. It is that "The air is heavy with moisture" when it is likely to rain. Of course the notion is wrong in both of its two possible aspects: (1) because of the molecular weights of water and of the hydrogen-oxygen mixture. If all the molecules of water vapor in a given volume of saturated air were taken out and replaced by an equal number of air molecules, all other conditions being unchanged, the weight would be increased by something of the order of one per cent. Dry air is heavier than moist air. (2) When it is likely to rain the barometer is invariably low and therefore the weight of the whole atmosphere above a given area of the earth's surface is proportionally less than on a fine day when the barometer is ordinarily higher. Yet, if you try to get an average university student to understand these facts, he is very apt to simply look reproachfully or

pityingly at you. If he has enough nerve he may tell you that every one knows that the air is heavy on a muggy day because you can feel it so. To him it is a question of psychology and not of physics. One is tempted to wonder what the writer of the news item feels about it.

J. G. DAVIDSON

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SCIENTIFIC BOOKS

THE CEREBRUM

Emanuel Swedenborg. Three Transactions on the Cerebrum. Now first translated by ALFRED ACTON. Philadelphia: Swedenborg Scientific Association. Vol. 1, 1938. xxxiii + 731 pp. "Anatomical Plates" (bound as a separate volume, 175 pp., 148 figs.) Vol. 2, 1940. viii + 179 pp. $12.00.

EMANUEL SWEDENBORG entered the field of neurology with an essay "On Tremulation." He had studied Willis and Vieussens, but was under the spell of Baglivi's "De Fibra Motrice." Baglivi, working with Pacchioni, had seen the dura mater pulsate with powerful systole and diastole, and had called it the heart of the brain. The cerebral cortex, they agreed with Malpighi, consisted of minute glands which extracted a nervous fluid from the blood and discharged it through excretory vessels that made up the white or medullary substance. Thence the nervous fluid was sent through the peripheral nerves to all parts of the body, impelled in the twinkling of an eye, with the velocity of light, by the contractions of the dura mater. Every one knows, says Baglivi, how swiftly a sensory impression made by external objects is conveyed to the mind's chief domicile, the cerebrum; and he discusses the transmission of *oscillations* through solids and through liquids.

For Swedenborg the oscillations are *tremulations,* and life (audition, vision, every sensation and motion) consists of these little vibrations—stillness and rest is death. Impacts from without are received by the cuticle, "which is nothing but a ramification of nerves," and are conveyed centrally along the nerve sheaths which are extensions of the dura mater. "The meninges produce a continuous system of membranes over the whole body." "The dura mater," for example, "applies itself closely to the bones," sending little tendons or threads far into their substance. Bone and periosteum are good transmitters, as are other membranes save when slack, so that reception, spreading like lightning through connective tissue misinterpreted as nerve, is diffuse; yet in the meninges "reside the most subtle sensations."

Outgoing tremulations in the nervous fluid follow the nerves into "finer and finer branches until they are finally expanded into membranes," and the circuit is complete. The fluid distilled into the medullas flows "through the nerves into the membranes and then back again to the medulla, making a circulation similar to that of the blood." Fear, with low blood pressure and therefore slack membranes, prevents transmission of the nervous fluid and paralyzes. In telepathy one's membrane "trembles from the tremulation of the other person's cerebral membranes, just as one string is affected by another, if they are tuned in the same key."

With visions of a new neuropathology, Swedenborg published in briefest note nine "rules" of tremulation (1718), and prepared a manuscript on that subject which he handed to the Royal Medical College a year later. The Board of Health (Sundhets Collegium) to whom it was referred for an opinion, passed it around and lost it; Swedenborg did not preserve the original draft, and all that remains of it is indeed the essential part, which he had sent with interesting letters, to his brother-in-law, librarian of the University of Upsala.[1]

For the next 15 years Swedenborg was occupied "exclusively with mineralogical and metallurgical studies," which led to his *Opera philosophica et mineralia* (Leipzig, 1734, 3 vols., fol.). Then he returned to neurology, reading and copying excerpts from nearly all the standard texts. In 1734 he published also "De Infinito," or, in its English translation, "The Philosophy of the Infinite,"[2] in which he considers the relation of soul and body, and concludes: "The soul resides particularly in the cortical substance of the cerebrum, and partly also in the medullary, where exquisitely subtle membranes can run connectedly from particle to particle, likewise above, around and within every particle of the above substance." This idea of the prime importance of the cerebral cortex was not new. Willis (1664) had said that the reason for the duplex substance of the cerebrum appears to be that the cortical part exists to *produce* the "animal spirit," and the medullary portion to distribute and utilize it. Varolio (1573) in colorful lines had declared the white substance of the cerebrum to be the mirror of the intellect and servant of the mind, since he considered the gray layer merely as white discolored through its great vascularity.

Captivated by neurology, Swedenborg in 1736, at

[1] "On Tremulation," by Emanuel Swedenborg. Translated by C. Th. Odhner. Boston [1899]. xiii + 79 pp. (This includes parts of the letters, the entire publication of 1718, and all that remains of the 1719 MS.)

[2] Outlines of a philosophical argument on the infinite, and the final cause of creation and on the intercourse between the soul and the body. Transl. from the Latin by J. J. G. Wilkinson, London, 1847. xxx + 160 pp. Reprinted as "The Philosophy of the Infinite," Boston, 1848. 64 pp.

the age of 48, obtained leave of absence for travel and intensive study in that field. He spent a year and a half in Paris, presumably frequenting Dr. Petit's School of Chirurgery, and went on to Venice, where, in 1738, he completed the manuscript which forms Volume 1 of Dean Acton's translation. Volume 2 consists of the "Amsterdam additions" thereto (1740). His plan was to copy whatever had been published on a given topic that seemed to him significant, here presented under the caption, "Anatomical Experience," and then to write his "Inductions" therefrom. Anatomy and Induction thus alternate through the volume, on 31 major topics, with an interruption of 10 pages to state that it is inadvisable to consider the brain piecemeal, and to define "animal spirit." We are told (p. 422) that "the cerebrum as affirmed by Hippocrates, Malpighi and others is the most perfect of all glands: that nowhere else can the marvellous nature of glands be explored to better purpose."

The importance of Swedenborg's neurological studies is not so much from observations of his own, as from an uncanny appreciation of what was sound in the literature, especially the recent literature. He has perhaps overstated this in a remarkable passage in his "Oeconomia regni animalis,"[3] abbreviated as follows (Clissold's translation, Vol. 1: p. 7–8):

> In the experimental knowledge of anatomy our way has been pointed out by men of the greatest and most cultivated talents, such as Eustachius, Malpighi [and 18 more whom Swedenborg names]; whose discoveries, far from consisting of fallacious, vague, and empty speculations, will forever be of practical use to posterity. . . . There are others again who enjoy a natural faculty for contemplating facts already discovered and eliciting their causes. Both are peculiar gifts and seldom united in the same person. Besides, I found that as soon as I discovered anything that had not been observed before, I began (seduced probably by self-love) to grow blind to the research of others . . . [warping and twisting other phenomena into conformity with my supposed invention]. I therefore laid aside my instruments, and restraining my desire for making observations, determined rather to rely on the researches of others than to trust to my own.

With the scalpel and probe, Swedenborg also laid aside his pencil, for we have apparently only one neurological drawing that he made—a simple figure of his dissection of a duck's brain in dorsal view, to show the "innumerable" twigs between the cerebral artery and the sagittal sinus.[4]

With neither pictures nor descriptions of his own work, it is often difficult to distinguish Swedenborg's original observations from speculations and quotations. For example, as to the finer vessels of the cortex, he writes (p. 22–23):

> From the experiences adduced it seems inferable to some extent that the cortex, so called, is the noblest substance of the brain, the individual parts whereof are woven of arteries which have terminated in the most delicate threads. . . . What specifically that tunic is, which by means of arteries is transmitted to the spherules of this cortical substance is a matter that can not be explored by help of the senses. From various signs, however, it would seem possible to conclude that it is the *inmost tunic of the arteries.* These arteries when they enter the cerebrum always relinquish their outer coat and also their muscular, while the inner coat is continued even beyond the meninges; and this conducts the purest blood into the cortical substance itself, and thence into the fibrils. This will be further confirmed in the Transactions on the Arteries of the Brain.

Worthy of a Nobel prize! Since all vessels at first are endothelial *intima* and nothing more, and all perfected vessels are but this intima covered by accessory coats which are gradually lost on approaching the capillary ramifications, Swedenborg here seems to have experienced a revelation. Yet what in fact is visible with a good microscope, he declares can not be seen. Willis, who had attempted to picture and describe this intima, had no such comprehensive idea of it. But Swedenborg in that later reference (p. 236–7) rather spoils it all by saying that the vessels of the whole cerebrum are in no way ruled by the heart and vagus nerve—"the internal carotid artery puts off its muscular and other tunics and *puts on tunics wholly different,* to wit, a membranous tunic borrowed from the dura mater, and a filamentary or reticular tunic borrowed from the sympathetic nerve: it retains, however, its own inmost tunic." Histologists know nothing of this change of coats. Elsewhere (p. 283) Swedenborg describes the intercostal nerve and par vagum, not as alternatives or antagonists, but in close companionship in the vessel wall, "so that the artery or vein knows not by what motory it is caressed." The nerve enters the vessel wall "in a friendly fashion and nowhere is dissension to be seen."

[3] Swedenborg, E. Oeconomia regni animalis in transactiones divisa. 4to Pt. I, Londini et Amstelodami, 1740. Pt. II, Amstelodami, 1741. [Swedenborg's ''regnum animale'' is not Cuvier's, since ''animalis'' here means ''pertaining to the soul.''] The Economy of the Animal Kingdom, considered anatomically, physically and philosophically. Parts I and II. Translated by A. Clissold. London and Boston, vol. 1, 1845: vol. 2, 1846. Also, 2 vols. Boston, 1868; also (the ed. here cited) New York [1903] vol. 1, 564 pp.; vol. 2, 432 pp. (See ''A Bibliography of the Works of Swedenborg'' by James Hyde. London, 1906. xvii + 742 pp. 3,500 items.) Part III, transl. by A. Acton, Philadelphia, 1918. lxii + 385 pp.

[4] The Economy of the Animal Kingdom, Vol. 2, p. 94. No figure by Swedenborg accompanies Dean Acton's ''Three Transactions'' but an unnumbered, unpaged volume of ''Anatomical Plates'' has been provided, selected from 20 of the authors cited by Swedenborg. The plates, with explanations conveniently opposite, are arranged alphabetically by authors, from Bartholin to Willis. Malpighi, with 26 pages of pictures, chiefly of the chick, is perhaps predominantly represented. There are 21 pages of Vieussens' plates, 14 from Willis, 8 from Ruysch, etc.—an instructive assemblage of curious old drawings.

Swedenborg also had glimpses of a neuron theory, built upon Malpighi's observation of "glands" in the cortex, which were presumably groups of cell bodies. Leeuwenhoek had seen the smaller individual "globules," none too clearly distinguished from droplets of myelin and other debris. Swedenborg stated that there was no "scarcely visible spherule of the cortical substance" that does not "bring forth a fibre as its own proper path of determination";—"the beginnings of the fibres are indeed as many in number as are the spherules of this substance." Thus he anticipated the demonstration of neuraxons. Dendrites he less clearly adumbrated in the capillaments too fine for red blood to enter, which connect the vessels with the spherules. Each spherule which thus receives and discharges is a "brain in least effigy"—a "cerebellulum."

Swedenborg's recognition of motor areas in the cortex is the acme of these divinations, accounted by Gustaf Retzius, in his presidential address before the Anatomical Congress of 1903, not merely as "recht merkwürdig" but as "wunderbar" and "erstaunenswert."[5] For Swedenborg not only knew that such centers existed, but "on the whole he correctly described their location,"—that for the leg above, trunk in the middle and head below, in the anterior portion of the hemisphere, being related to the body "in an inverse ratio." The historian Neuburger was profoundly impressed.[6] Ramström, seeking to account for this "work of genius," believes that pathological cases, combined with pictures and findings of Vieussens, were the source of Swedenborg's conception.[7] But, as the present reviewer has noted, when Swedenborg declares that the determination of what convolution corresponds with this or that muscle of the body can be made only "per experientiam in vivis animalibus, per *punctiones, sectiones* et *compressiones*" he recommends a succession of procedures that he learned from Baglivi. The latter studied the nerve sheaths in living animals *"varie punctis, resectis, affectisque."*

Retzius intimates that Swedenborg discovered the central canal of the cord and the cerebro-spinal fluid. An easy reference to Burdach would have shown that the central canal was found by Estienne (1545) and that Columbus, Piccolomini, Bauhin and Malpighi had considered it normal; moreover, Swedenborg merely surmised its existence. The cerebro-spinal fluid, as the reviewer finds, was known to Coiter in its usual thin and occasionally thickened condition (1573). Whatever is new in Swedenborg is not labeled as such, and often is buried in fiction and romance, not always "lustrous with points and shooting spiculae of thought":—"The pons is the bed or conjugal chamber or couch for both the brains; for there like a pair of consorts, they join their first embraces and enter into a common covenant for the conception and bringing forth of their nerves."

Swedenborg has made a long story of his progressive study of the brain, nearly all of which is now available in English, included in the following works. On Tremulation, 79 pp.; The infinite, 160 pp.; Three Transactions, 2 vols., 910 pp.; Economy of the Animal Kingdom, 3 vols., 1,381 pp.; The Brain, 2 vols., 1,439 pp.; Animal Kingdom, Part 3, 226 pp. Even when Swedenborg tore vertically in halves eight pages of Latin manuscript and threw one half away, the missing portion has been conjectured and added so that not a line be lost. It remains for some neurologist to discard the quotations, repetitions and revisions, and present Swedenborg's contribution in a form that does not require a Swedenborg research on the part of every reader. For it is clear that Swedenborg deserves an honorable place among the "Apostles of Physiology"—a place that too often has been denied him. Essential for this undertaking are the Three Transactions, now made available by Dean Acton, through his scholarly and devoted labor, in the highly commendable volumes here inadequately reviewed.

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REPORTS

STATEMENT OF CONDITIONS OF THE AMERICAN CHEMICAL SOCIETY

THE American Chemical Society is still growing in numbers, in prestige and in influence, far more so than some of us who have been in closest touch with its progress had any reason to hope. It simply means that American chemists are more and more realizing that the American Chemical Society is their friend, is interested in their welfare, is doing all it can to enable them to develop themselves, and that membership in the society is a catalyst to success. Its efficacy is not

[5] "Emanuel Swedenborg als Anatom und Physiolog auf dem Gebiete der Gehirnkunde." *Verh. d. Anat. Ges.*, pp. 2–14, 1903.

[6] Dr. Max Neuburger. "Swedenborg's Beziehungen zur Gehirnphysiologie." *Wiener Med. Wochenschr.*, Jahrg. 51, col. 2077–2081, 1901.

[7] Martin Ramström. Emanuel Swedenborg's investigations in natural science, and the basis for his statements concerning the functions of the brain. Kungl. Vetenskaps-Societet., Uppsala, 1910, 59 pp., fol.

always appreciated by individuals who lack real professional consciousness.

The society now has 30,400 members, of which slightly over 3,000 have joined in 1942. There has been a loss of approximately 1,000 subscribers to the *Journal of the American Chemical Society;* 1,200 to *Chemical Abstracts;* 1,600 to *Industrial and Engineering Chemistry;* and 1,400 to *Chemical and Engineering News,* in foreign countries to which publications can no longer be sent and from which payment can not be received. In spite of this, on April 1, 1942, the *Journal of the American Chemical Society* had 60; *Industrial and Engineering Chemistry* 431; and *Chemical and Engineering News* 1,481 more subscribers than on April 1, 1941. The subscription list of *Chemical Abstracts,* on the other hand, has, on account of large foreign circulation, decreased 342 between these two dates. Income from subscriptions, since the increase was largely due to subscriptions at the special rates given to members, is so far approximately $7,000 less in 1942 than in 1941 on the same date.

Some of the society's current specific accomplishments for its members, outside of normal procedure, are herewith brought to your attention.

The Committee on the Professional Training of Chemists has collected complete lists of the students in our colleges and has sent a special questionnaire to all these students for registry in the National Roster of Scientific and Specialized Personnel. At this time, the committee has been in session for four days and evenings, continuing its strenuous labors in studying and accrediting the chemical departments of our educational institutions. The society owes the members of this committee a debt of gratitude for accomplishments which are having, and will continue to have, a far-reaching effect on our professional standing and on the quality of the chemists and chemical engineers whose services are in future to be utilized by our country.

The Employment Clearing House is again functioning, and continues to give unusual opportunities to our members for contact with our best employers, thus rendering a service unsurpassed by any professional group. In order that those principles may be implemented, it is open only to employers who agree to the basic principles laid down by the Board of Directors in its action taken at Atlantic City on "Employer-Employee Relationships" (see *News Edition,* Vol. 9, p. 1014, September 25, 1941). A number of firms have written the society, stating that they were carefully revising their lists of employees to be sure that they met at least the minima set by the directors, and a number of firms have stated that they are, and have been, exceeding the recommendations for salaries to graduate chemists and chemical engineers. From the reports coming from our colleges, it is very evident that the young men being graduated this year are receiving distinctly higher offers of compensation than in previous years. Unfortunately, this is not true of all employers and explains in part the number of individuals registering for employment or change of employment in the Employment Clearing House. Practically all those registered are seeking change of employment, the number of unemployed registrants being negligible.

The American Chemical Society Committee on Cooperation with the National Defense Research Committee sent out a questionnaire last December, the results of which were embodied in the article, "The 'Production Army' *vs.* the 'Combat Army,'" which appeared in the February 10 *News Edition.* This, too, has had its influence on a desire for change of employment, but it has been especially helpful in convincing authorities directing the war effort that there is a very serious scarcity of chemists and chemical engineers for the "Production Army," and that replacements for any who may be inducted are almost impossible unless other serious vacancies are created.

Expenses for paper and printing are increasing, the directors having found it necessary to modify the society's contract with the Mack Printing Company to help meet additional costs forced upon the company in connection with labor and materials. Nevertheless, it is anticipated that with the increased support from American chemists we will again be able to balance our budget.

One of the society's most noteworthy accomplishments of the past year was the quite definite establishment of the full professional status of our members and the legal recognition of graduate chemists and chemical engineers as professional men. To-day, full membership in the American Chemical Society is a far better guarantee of professional standing and status than can be given by any state licensing board. Through the interest, encouragement and support given by the American Chemical Society to its members at the Shell Development Company in Emeryville, California, it has been legally established that professional men can not be forced to submit to inclusion in any organization controlled by heterogeneous groups of non-professional men. It is a decision of far-reaching importance to the chemical profession, as outlined in the article on page 165 of the February 10 issue of *Chemical and Engineering News.* The National Labor Relations Board decision, No. R-3245, and briefs containing a compilation of the laws governing these case matters, are available to groups of our members who may be threatened with coercion. All this was promised to the membership when the Committee on Economic Status was appointed. This

committee has been exceedingly active, and its report presented at this meeting, which will be published in detail in *Chemical and Engineering News* and reprinted as a separate document, will bring much important and useful information to the chemical profession.

The secretary's office has been especially concerned with, and active in, problems affecting the proper allocation of chemists and chemical engineers in the country's war effort. It is quite definitely recognized and admitted that the normal place for chemically qualified men is in the "production army," for it is there that true patriotism requires them to serve. Without them, the combat forces simply can not be supplied with the materials and implements of warfare. On the whole, Selective Service has functioned efficiently. General Hershey and his corps of assistants are exceeded in efficiency and intelligence by no other group in the Army or Navy. The local boards are made up of patriotic citizens and, for the main part, of intelligent citizens. It would be surprising if all the 6,600 local boards contained men who were capable of judging the importance to the war effort of graduate chemists and chemical engineers. Many mistakes have been made. Several hundred chemists and chemical engineers, including some with seven years of training and additional years of experience, have been inducted into the Army and are now functioning as stretcher bearers, orderlies, pharmacists' clerks, and in other necessary occupations, but occupations in which high-school graduates could function with equal efficiency. As a consequence, their years of special training and experience are lost to the country. For reasons which no one can explain, there are apparently no channels in the War Department through which this man power can be assigned to chemical work, either in the production or combat armies. The situation is just as serious as if graduates of West Point were assigned to the ranks as privates. All efforts to remedy this situation have completely failed, in spite of the fact that the entire matter has been forcefully presented to high authority. In many instances, also, students of chemistry and chemical engineering have not been allo to complete their courses, which procedure is cert to deplete future supply should the war conti These mistakes, however, have been caused by a few the local boards only, and are not the rule. When a peals are properly made, and when details can be se in time to Selective Service Headquarters, deferm for service in the "production army" is usually cured. Once inducted, the best trained chemists a chemical engineers are simply "genus homo" and present nothing can be done toward utilizing th qualifications in the country's service.

In contacting local boards, employers should c attention to Selective Service Memoranda I-3 I–398 and I–405. If the men who have been called the draft are necessary men in work essential to t national health, safety and interest and to the w effort, the employer should make every effort to that deferment is allowed. If the local board refu the case should be immediately appealed to the App Board. When an appeal is taken but not befo if the employer will send to the secretary's offic copy of Form DSS 42A used in the appeal toget with the selectee's number and local board number a address, the case will be referred to Selective Servi Headquarters in Washington for such advice a recommendation as the premises may warrant. S appeals, when justified, have usually been grant Eliminating previously mentioned errors, chemists a chemical engineers of America, with the exception the group brought into the Army through their co mitments as reserve officers, are serving the natio war effort where they feel they can serve best.

The American Chemical Society has to-day a l of 60,000 individuals who, at least, believe themsel to be chemists or chemical engineers with data as the training and experience of each. It has been inestimable value to the society, and has greatly help to implement its aid to both the production and comb armies.

CHARLES L. PARSONS,
Secretary

SPECIAL ARTICLES

SOME PRECOCIOUS DEVELOPMENTAL CHANGES PRODUCED BY ADRENAL CORTICAL HORMONES

THE more important functions ascribed to the adrenal cortical hormones are their ability (a) to maintain life, (b) to maintain at normal the carbohydrate levels in the tissues and (c) to maintain at normal levels the sodium, potassium and water balance in adrenalectomized animals. On the other hand, excessive amounts of these hormones may be pr sumed to be present in patients with adrenal corti tumors, who may show marked bodily changes, th most pronounced of which are modifications of th sexual characteristics. These are attributed to th endocrine secretions of the tumor, among which ha been identified several of the sex hormones (Reic stein, Kendall). When these tumors occur in ful grown adults, it is difficult to delineate changes oth than those upon the sexual functions. However,

se reported by Fraser,[1] an adrenal cortical tumor one-year-old male child not only resulted in preous development of the secondary sexual characstics but also in precocious skeletal and dental wth. The epiphyses at one year were similar to e in a five-year-old child and the dentition was of a three-year-old child. These changes may be to the sex hormones alone, to the adrenal cortical mones alone or to a combination of these.

he purpose of the present report is to record the nges produced upon newborn rats by certain of adrenal cortical hormones during the period when greatest postnatal developmental changes normally ur.

ver 200 newborn albino rats of the Sherman strain e employed. Experiments were performed in ch either desoxycorticosterone acetate (DCA)[2] in me oil or commercially available aqueous adrenal ical extracts[3] were injected subcutaneously. These were controlled by injections of equivalent unts into litter-mates of either sesame oil or ger's solution. The sexes were about equally ded in the experimental and control groups. A up of 32 newborn rats was observed during the e period, but the rats received no injections whatr. The DCA was injected in daily doses of 0.25 0.50 mg and the adrenal cortical extracts in daily es of 0.1 to 0.6 cc. Within the first 24 hours of , the preparations, especially DCA, proved toxic resulted in a high mortality. However, when the ections were begun after the first day, there was no dence of toxicity and no consistent difference was ed on the body weight between the hormone-inted and the corresponding control litter-mates. ir growth, determined merely by gross observan, was uninfluenced.

n the hormone-injected rats the incisor teeth pted approximately on the ninth day of life, which always about 24 hours earlier than in the control er-mates. Two to 3 days later the lower lip could separated easily from the adjacent gingiva, reveal a large extent of the incisor teeth. At this time lips of the control litter-mates were not as well eloped and still firmly attached.

he eyelids of the baby rats began to separate at proximately two weeks of age. The eyes of the mone-treated rats invariably opened 1½ to 3 days ore those of the litter-mate controls. It was quite striking to see the hormone injected baby rats with eyes wide open, when the eyelids of every one of the litter-mate controls continued tightly sealed.

The precocity, as evidenced by the advanced eruption of teeth and opening of the eyes, is based on gross observation. It is believed that many other changes may be taking place which require more detailed study.

Growth hormone, the sex hormones and some other substances which have been injected into baby rats did not influence the time of eruption or of eyelid opening. These experiments will be detailed in a more complete communication.

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Columbia University

[1] I. Fraser, *Brit. Jour. Surg.*, 27: 521, 1940.

[2] Kindly supplied by Ciba Pharmaceutical Products, ., and Roche-Organon, Inc.

[3] Three preparations of aqueous adrenal cortical ext were used. One was kindly supplied by the Upjohn mpany. We are also indebted to Mr. L. Caplan, of the mptroller's Office, Inspection Division, City of New rk, for a generous supply of Eschatin and of Wilson's renal Cortex Extract.

LACTATIONAL PERFORMANCE AND BODY WEIGHT*

Figure 1 shows the relation of milk-energy production to body weight in mature animals of different species: dairy cattle (average of 368 "good" cows), dairy goats (average of 7 "good" goats) and white rats (average of 5 excellent rat mothers).

The data are generalized by the equation $Y = aW^b$ in which Y represents milk-energy production and W body weight.

The value of b, the slope of the fitted line on the logarithmic or percentage grid, is about 0.7: the differential percentage increase in milk-energy yield is 0.7 as rapid as the corresponding percentage increase in body weight; increasing body weight 1 per cent. increases milk-energy yield 0.7 per cent.

The precise numerical value of the slope b varies with the relative "dairy merit" of the animals. The significant fact is that milk-energy production tends to vary with W^b and the value of b is 0.7 ± 0.1.

This is significant because the minimum maintenance cost (basal energy and endogenous nitrogen metabolisms), weights of neuro-endocrine organs, cross-section areas of the circulatory and respiratory vessels, circulation and ventilation rates, external and nutritive and excretory surfaces vary in similar manner.[1] These percentage parallelisms bring out a fundamental unity in apparently diverse structures and functions.

The fact that these structures and functions tend to vary with $W^{0.7}$ rather than with $W^{1.0}$, might have been inferred from geometrical and mechanical considerations. Geometrically viewed, surfaces tend to vary

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 822.

[1] *Univ. Missouri Agr. Exp. Sta. Res. Bulls.* 328 and 335, 1941.

with $W^{2/3}$; mechanically viewed, the pull of gravity varies with $W^{1.0}$ while the strength of the supporting structures tends to vary with $W^{2/3}$ (that is, with the cross-section areas of the supporting structures); hence, to retain stability the supporting structures must grow more rapidly than the visceral organs, or the visceral organs must grow less rapidly than the body as a whole, approximately in proportion to $W^{2/3}$; and it is the metabolism-supporting visceral organs and nutritive and excretory surfaces that condition and limit the functional rates: basal metabolism, apparently milk-production, and perhaps all vital and productive processes. If the small and large animals were similar and if the body did not develop devices for partial compensation of these geometric and mechanical limitations, the slopes of the curves relating these structures and functions to total body weight could be predicted precisely from geometric and mechanical considerations; since, however, small and large animals are not similar geometrically, mechanically or temporally, the value of the slope b in Fig. 1 for lactation, and for related structures and functions, can not be predicted precisely, but it may be said to be of the order of 0.7 ± 0.1.

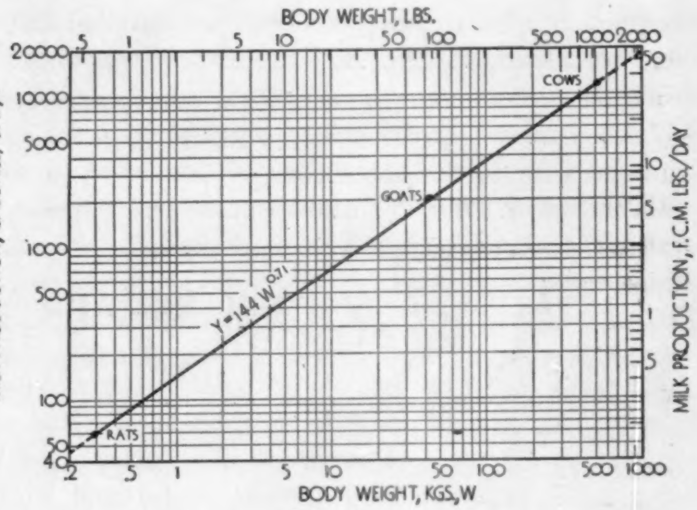

FIG. 1

The observation that *minimum* maintenance cost (basal metabolism) and milk production follow a parallel percentage course with increasing body weight suggests an economic application. If the *total* maintenance cost likewise parallels milk production with increasing body weight, the gross energetic efficiency of milk production (ratio of milk-energy produced to digestible feed-energy consumed) should be independent of body weight[2]; and if it is, the monetary profit of milk production should rise with increasing body weight because a major part of the expense of commercial milk production is for the labor of milking, feeding, cleaning, bookkeeping, housing, and so on; and such labor per animal is, within the species at any rate, practically the same whether it be relatively large or small. Hence, *within a given gross energetic-efficiency class,* the larger the animal the less the labor cost per unit milk-energy produced and, *if other conditions are equal,* the greater the profit per unit milk produced, and still greater per animal and per herd.

Unfortunately, it is not known how total maintenance cost varies with increasing body weight. It may rise more steeply than basal metabolism because the energy cost of moving the body is directly proportional to $W^{1.0}$ rather than to $W^{2/3}$. However, the voluntary movements may decline with increasing weight in such manner that the total maintenance-energy cost parallels the basal metabolism cost. Thus large animals appear to make fewer and slower movements than small, and the energy expenditure at approximately physiologically-equivalent work levels parallels the basal-metabolism energy in 1,500-pound horses, 700-pound ponies, and 150-pound men.[3] The data in Fig. 1 do not throw convincing light on the maintenance problem. The gross energetic efficiencies of milk production in the small animals in Fig. 1 were higher than in the large[4]: cows 31 per cent., goats 35 per cent., and rats 44 per cent. These differences may be fortuitous, but they may also indicate that total maintenance-energy cost rises more steeply with increasing body weight than milk-energy production, due either to selection factors or to physico-chemical inter-relations having a similar effect.

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EFFECTS OF Ca AND OTHER DIVALENT IONS ON THE ACCUMULATION OF MONOVALENT IONS BY BARLEY ROOT CELLS

THE concept of antagonism holds that Ca and other divalent cations retard the entrance of monovalent ions like K and Na into the plant cell. The experiments upon which this theory is based were, in general, performed with high and often toxic concentrations of salt on cells or roots with little regard to their metabolic status.

[2] There is no reason for assuming that it takes different amounts of feed-energy to produce unit milk-energy in, for example, 800- and 1,600-pound cows if the maintenance cost is excluded from the computations (*net* efficiency). If the maintenance item is included, the ratio of milk-energy produced to total feed-energy consumed (*gross* efficiency) is the same if the ratio of milk-energy produced to maintenance-energy is the same in large and small animals. If, however, the maintenance-energy rises more rapidly than milk production with increasing body weight, the gross efficiency decreases with increasing body weight.

[3] *Univ. Missouri Agric. Exp. Sta. Res. Bull.* 222 and 244.

[4] *Id., Res. Bull.* 285 and 291.

Recent investigations on the absorption of K and Br by actively metabolizing excised root systems of barley like those used by Hoagland and Broyer[1] showed that Ca and other cations appreciably increased the rate of absorption of K and Br as shown by analysis of sap expressed from previously frozen roots. Data from a typical experiment of 10 hours duration are shown in Table I.

TABLE I

Solution	Absorption in milliequivalents per liter of sap	
	K	Br
.005N KBr	24.7	15.9
.005N KBr + .001N $CaSO_4$	28.6	23.5
.005N KBr + .005N $CaSO_4$	30.9	24.8
.005N KBr + .025N $CaSO_4$	37.2	30.1

Potassium absorption from KNO_3 and K_2SO_4 solutions was also increased by Ca.

In several experiments it has been found that Ca may increase K absorption by 80 and Br by 100 per cent. without affecting the rate of CO_2 production.

Barley roots responded to Ca during simultaneous K and Br absorption regardless of their initial Ca content. Roots grown in the preliminary period in nutrient solutions saturated with $CaSO_4$ responded fundamentally the same as roots grown at lower Ca levels when subjected to study over a subsequent experimental period. Pretreatment of roots for 4 hours in saturated $CaSO_4$ solution produced no change in the rate of K and Br influx from dilute KBr solutions as compared with control roots kept in distilled water during the pretreatment period.

Roots maintained at several controlled temperatures from 10° C to 30° C all responded to the presence of Ca in the solution by increased rates of K and Br absorption.

Calcium was always more effective than Mg and Mg more effective than Sr of like concentration in increasing the absorption of K and Br. Ba produced effects which depended upon the concentrations used, dilute solutions producing increases in K and Br absorption and more concentrated solutions producing decreases. Mixtures of Ca and Mg sulfates produced increases in salt absorption of the same general magnitude as did these salts used singly. This indicates that Ca and Mg are not performing independent functions but are performing some common function, Ca being more efficient than Mg.

These results suggest the possibility that Ca and kindred cations can increase the permeability of the plasma membrane to K and Br during concurrent salt accumulation.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

USE OF COMPLETE FERTILIZERS IN CULTIVATION OF MICROORGANISMS

Sometimes experimental work requires the use of very large quantities of a culture containing microorganisms. For example, in the studies conducted by the authors on the physiology of feeding of oysters as much as 90 gallons of a rich culture of plankton were needed every day for a period of several weeks. Obviously it was impractical and virtually impossible to grow such large quantities of microorganisms by employing standard laboratory technic and using a culture medium such as Miquel's. Therefore, a different method was sought. A large number of commercial fertilizing mixtures were tried, and several of them gave excellent results.

The use of various fertilizing substances in fish ponds and small lakes has long been practiced in Europe. Recently a number of American workers, notably Wiebe[1] and Swingle and Smith,[2] contributed to our knowledge on the use of fertilizers in increasing the fish production of small bodies of fresh water. As a rule, after the addition of fertilizers, a significant increase in phytoplankton occurred. This in turn was followed by a prolific growth of zooplankton.

The fertilizing mixtures used in our studies are known as complete fertilizers. They are usually designated by a formula such as 5–3–5; 6–3–6; 10–6–4, etc., which indicates percentages of compounds of nitrogen, phosphorus and potash. Many of these fertilizers contain large quantities of organic components such as cottonseed meal, castor pomace, soyabean meal and steamed bone meal. There are also traces of copper, zinc, manganese, boron, iron and some of the other elements. Of the numerous mixtures tried the fertilizers 5–3–5 and 6–3–6 gave the best results. Both these fertilizers are used by tobacco growers. The relative value of each fertilizer was determined in a series of controlled laboratory experiments of growing cultures of *Chlorella* and *Nitzschia* in media prepared from each fertilizer.

For laboratory work a medium containing 1 gram of fertilizer in 1,000 cc of filtered sea water always gave excellent results. In growing *Nitzschia* and

[1] D. R. Hoagland and T. C. Broyer, *Plant Phys.*, 11: 471–507, 1936.

[1] A. H. Wiebe, *Bull. Texas Game Fish and Oyster Comm.*, 8: 1, 1935.

[2] H. S. Swingle and E. V. Smith, *Trans. American Fish Soc.*, 68: 126, 1939.

Chlorella this concentration very often gave better results than when Miquel's solution was employed. Concentrations 1:5,000 and even 1:10,000 were also found satisfactory. In preparing a medium a comparatively large quantity of fertilizer should be ground, and from it the needed quantity taken and placed in the water. This will insure relative uniformity of the samples. When very large quantities of fertilizer are used, as is often the case in field experiments, no grinding is necessary. Using these fertilizers, exceedingly rich cultures of *Chlorella, Nitzschia closterium* and *Prorocentrum triangulatum* were grown in large outdoor tanks having the capacity of several thousand gallons. In addition to the forms mentioned above many other microorganisms were successfully grown in our media under laboratory conditions and in the outdoor tanks. Chlorophyll-bearing and colorless flagellates grew exceptionally well, while Ciliates such as *Colpidium, Glaucoma* and *Paramecium* produced good cultures.

There are several advantages of using complete commercial fertilizers for maintaining stock cultures in the laboratory and for growing mass cultures of microorganisms under field conditions. In the first place, the method is very simple, consisting of only one step of adding one gram or less of the fertilizer to a liter of sea or fresh water. Secondly, some of the substances composing the fertilizers enter into solution almost immediately, thus providing nutritive materials for newly started cultures. Its other components, however, require different periods of time before they are converted into the substances which can be utilized by the cultured organisms. Because of such a delayed but continuous supply of nutritive materials the cultures remain viable and active for many months, thus eliminating the necessity of frequent transfers for the maintenance of stock cultures. Cheapness of the material used in the method is another important advantage. One pound of fertilizer costing from 3 to 5 cents is sufficient for making almost 500 liters of culture medium.

It is thought that the suggestions offered in this brief article are especially pertinent at this time. Because of the war condition it is becoming more difficult to buy the chemicals usually needed in the preparation of solutions for the cultivation of microorganisms. Some of the ingredients may not be available at all. Therefore, the use of commercial fertilizers, which at present are easily obtainable, may solve the difficulties of many investigators.

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AN INEXPENSIVE, QUANTITATIVE PUMP

THE apparatus shown in Fig. 1 was devised to meet the need for a convenient and relatively accurate means of adding specified quantities of reagents in routine analyses. Though not recommended for precise measurements, it will deliver quantities as small as 1 ml with an error of 1 per cent. or less if care is taken to exclude bubbles from the system, and the valves are properly adjusted.

The side hole in the 6 mm tube may be blown in the usual way, but care must be taken to shrink its margins flush with the rest of the wall. It should be 1 to 2 mm in diameter. The 6 mm tube is telescoped into

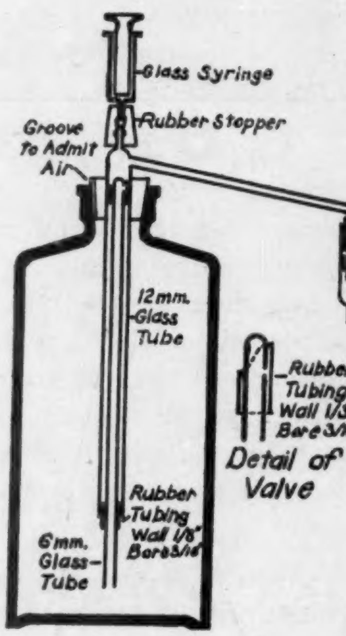

FIG. 1.

the 12 mm tube to allow the device to be used in bottles of various depths. If the 12 mm sheath is made 7 inches long and the 6 mm stem 8 inches, the apparatus can be adjusted to fit ordinary bottles varying from a quart to a gallon in size.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE MESOTRON

THE life of the mesotron, middle-weight atomic fragment, is probably the shortest span of existence of anything in the universe, despite new measurements reported to the American Physical Society in Baltimore on May 1, which have given it quite a boost. Experiments carried out at Echo Lake and at Denver, Colo., last year gave it a life of 1.6 millionths of a second, in substantial agreement with previous estimates. New and more accurate measurements this year give it a life of 2.8 millionths of a second.

The experiments were made by Drs. Bruno Rossi and Kenneth Greisen, of Cornell University; Drs. Joyce C. Stearns and Darol K. Froman, of the University of Denver, and Dr. Phillip G. Koontz, of Colorado State College.

Mesotrons are born high in the atmosphere through some action of the incoming cosmic rays. But few of them live to reach the earth. In fact, many of them expire in passing from the level of Echo Lake to the level of Denver, a drop of about 5,000 feet.

However, the new experiments confirmed what was previously found, that the faster the mesotron travels, the longer it lives—as measured in our time. But measured in its own time, mesotron time, all have about the same life span, 2.8 millionths of a second. This is called the "proper" lifetime of the mesotron, and is obtained from the experimental times by correcting them for the relativity effect of velocity on time.

Thus for a mesotron a fast life means a long life, contrary to the case for human beings. But if you were a fast-moving mesotron you would know nothing about this. Consulting your own watch—a perfect timepiece—you would find that you lived not a whit longer than if you stood stock still—2.8 millionths of a second in either case, no more, no less.

But observers on the earth, consulting their own timepieces—also perfect—would find that your watch was ticking more slowly—also that your little heart was ticking more slowly. So-o, it's all the same to you.

And if, doubting your own watch, you stopped to compare it with that of one of the observers, you would find both going at exactly the same rate. Thus, by your own heart beats, your "proper life" is always the same whether you travel or stand still, supposing you're a mesotron.—MORTON MOTT-SMITH.

A NEW DIFFRACTION GRATING

A DIFFRACTION grating that distinguishes between a new star and a planetary nebula was described at the meeting by Dr. R. W. Wood, of the Johns Hopkins University. The grating, 18 inches in diameter, has been made to fit the 18-inch Schmidt photographic telescope at Mt. Palomar, California, where the 200-inch telescope, the world's largest, is to be located. The grating throws a rainbow spectrum like a spectroscope, and shows a nitrogen band for the nebula very near the bright hydrogen line. This band is not seen with an objective prism.

The whole surface of the 18-inch disk is covered with straight parallel grooves or lines, accurately spaced and 1,500 to the inch. The grooves are so shaped that nearly all the light is thrown into the spectrum and the highest intensity is in the red region, where the hydrogen line is. A novel feature of this grating is that it is built up in sections like a mosaic. These sections measure 4x6 inches and are replicas of one master grating. The grating, when placed over the object glass of the telescope, draws out into a spectral streak every object in the field of the telescope. Another 18-inch grating has been made with but 900 lines to the inch in order to give short spectra; this is required when the field is crowded with many stars, for otherwise the spectra overlap. This grating throws most of the light in the blue end of the spectrum, and will be used for classifying faint stars according to their spectra.

TRIVISION

A REVOLUTIONARY advance in x-ray photography was announced by its inventor, Douglas F. Winnek, of Mount Vernon, N. Y., at the meeting of the New York State Medical Society.

Trivision is the name Mr. Winnek gives to his new technic for better x-ray pictures. By means of a special film, a single x-ray picture can be made to show length, breadth and depth—in other words, three dimensions. With the aid of a grid superimposed or printed on the emulsion plate of the film, measurements of these dimensions can be made from the same single picture.

A single trivision picture, for example, would show the surgeon whether a bullet or shell fragment was behind, in front of or to the side of a bone or other internal body structure. With the grid he could also measure accurately the distance of the bullet from the bone or other tissue. In case of broken bones, Trivision would similarly give swift, accurate information on the amount of displacement of the broken ends of the bone. To get this information at present, Mr. Winnek pointed out, surgeons must have stereoscopic pairs of x-ray pictures taken, must look at them in complex viewing devices and use tedious measuring technics.

Motion can also be reproduced on the Trivision film. Such actions as the winking of an eye, the rotation of a clenched fist and the meshing of gears have been recorded and the motion studied in three dimensions.

Trivision pictures, which can be made in color as well as black and white, are taken with a scanning camera on ordinary photographic film embossed on the base side with microscopically small lens ridges or lenticulations.

MICA PRODUCTION

THREATENED by the jeopardy of India with loss of high-grade mica vital to high-compression airplane motors and scores of electrical appliances, this hemisphere is looking for opportunities to begin a substitute mica industry. Not only did India produce 6,334 short tons of a total world production of 9,016 short tons, but her mica was

expertly graded and split by family labor content with 9 to 12 cents per day.

Argentina, Brazil, Mexico, Canada and the United States all have rich mica deposits, now being surveyed for increased production—but there is little expert mica labor, and none willing to work for Indian wages. Neither has western man invented a machine which can grade and split the delicate mineral as expertly as the swift hands of Indian families. Consequently mica users in this hemisphere, used to the excellence of the Indian product, have scorned efforts by near-by producers in Brazil whose grading was careless.

Several plans are under study for introducing the mica-splitting industry into this hemisphere. Canada already produces a small quantity of splitting and could produce more if prices rose. Mexico and Puerto Rico have been suggested, the latter on account of its abundant supply of cheap labor. But even in Mexico and Puerto Rico labor demands far higher pay than the workers of India.

Mica is important to electrical appliances because it can be divided into thin, flexible, transparent films which are unaffected by fire, water, electricity or acid, and whose volume remains constant in extreme heat and cold. These characteristics are found in no other substance, and no synthetic substitute having similar qualities has so far been discovered.

One of the most important uses of mica is in the insulation of airplane motor spark plugs, in which the mica forms a thin wrapping for the spindle, called "cigaret mica." All tubes in radio receiving sets require from two to four pieces of mica to hold the filaments upright and to keep the internal assembly rigidly in the center of the tube. In every tank, airplane and ship, mica is essential to the condensers.

Fortunately, large supplies of mica are found in this hemisphere. The United States and Canada have for some years been sources. The crucial problem in production, should the hemisphere be separated from Indian sources, lies in the lack of trained, cheap labor to grade and split the material.

SYNTHETIC PLANT HORMONES

New synthetic growth-promoting substances, or plant hormones, many times more powerful than those now in use experimentally and by greenhouse men, have been prepared at the Boyce Thompson Institute for Plant Research, Yonkers, N. Y., by Dr. P. W. Zimmerman and Dr. A. E. Hitchcock. Applied to plants in the form of vapor, spray, emulsion, lanolin paste, or added to the soil, they induce profound changes in growth, and they can also induce the formation of seedless fruits from unpollinated flowers at points on the stem a foot or more from the place of application. Treated plants are so changed that sometimes they look like different species.

The new hormones are prepared from various milk organic acids, which have no effect on plants in their ordinary state, by the addition of atom-groups containing chlorine, iodine or bromine, either singly or in combination. One very effective compound of this sort is known as dichlorophenoxyacetic acid. It has been found to be fully 300 times more effective in producing plant changes than indolebutyric acid, one of the synthetic plant hormones now widely used. Solutions as weak as 10 to 20 parts (by weight) in a million parts of water have been found most effective.

In all, eleven different compounds of the new class have been prepared. All seem to share the same great power over the growth and development processes of plants, and all seem to depend on the addition of one or more of the chlorine-iodine-bromine triad of elements (halogens, the chemists call them) to a weak organic acid foundation.

Drs. Zimmerman and Hitchcock warn against rushing into attempts at practical application without further experimentation: "Considering the activity of these new growth-modifying hormones and their capacity to cause extreme types of distortion, caution should be exercised in their practical application. In view of the tendency to include various types of hormones in fertilizers, fungicides, insecticides and other commercial preparations, the use of these new compounds should be preceded by extensive experimentation to make sure that they will not be detrimental to crops. Phenoxy compounds are known to have insecticidal value and now that they are also known to be plant hormones there might be a tendency to incorporate them in commercial sprays and fertilizers. The idea would be good, but the results might be disastrous."

THE CHEMICAL DICOUMARIN

Hope that the haystack chemical, dicoumarin, which reduces the clotting ability of the blood, may have wide usefulness as a life-saving remedy appeared in reports from two groups of investigators, although both stressed the fact that it is too soon after dicoumarin's discovery to be sure of its exact value.

Its use was reported at Atlantic City in cases of thrombosis (blood clot), diseases of the blood vessels including one kind of artery hardening, and subacute bacterial endocarditis (a form of heart disease) by Dr. Ovid O. Meyer and Dr. James B. Bingham, of the University of Wisconsin, and Dr. Irving S. Wright and Dr. Andrew Prandoni, of New York.

Dicoumarin, formed in the spoiling of sweet clover, was first isolated and then made synthetically without the haystack's aid by Professor Karl Paul Link and associates at the University of Wisconsin. He had become interested in the problem because when cattle eat spoiled sweet clover their blood loses its ability to clot and slight bruises may cause fatal bleeding. The possibility of using this chemical to prevent formation of frequently fatal blood clots which sometimes follow operations was suggested.

Success in preventing formation of clots in the large blood vessels of the legs after operation and in preventing a second clot on the lung in patients who have already had one, have been reported by Dr. Edgar V. Allen and Dr. Nelson W. Barker, of the Mayo Clinic and the University of Minnesota.

Dicoumarin, it is emphasized, does not dissolve or cure a blood clot once it has formed, and in Dr. Meyer's opinion there is not yet enough evidence to say that it prevents clot formation.

It has also a dilating effect on the small blood vessels

near the surface of the body and in the fingers and toes. This effect may be useful in cases where these small blood vessels are growing narrower because of disease such as artery hardening. Dr. Prandoni reported that it apparently acts to heal vascular ulcers through this dilating effect.

The chief disadvantage of dicoumarin is the danger of its causing severe bleeding. The chemical can be used safely if the dose is carefully controlled and the patient is in the hospital having tests made frequently enough to detect the advent of dangerous bleeding. Dicoumarin can be given by mouth as well as by hypodermic injection. This, with its cheapness, gives it an advantage over another anti-clotting chemical, heparin, obtained from animal tissues. Heparin acts immediately, however, whereas dicoumarin requires 24 hours to take effect. The bleeding that may follow dicoumarin can be controlled by transfusions of fresh blood but not by the anti-bleeding vitamin K. This and other evidence suggests that dicoumarin exerts its anti-clotting action on the blood in the liver.

THE ANTI-PELLAGRA VITAMIN

NICOTINIC acid, the anti-pellagra vitamin, has proved to be a successful remedy for Ménière's disease, according to the report of Dr. Miles Atkinson, of the New York Hospital and Cornell University Medical College, which appears in the *Journal* of the American Medical Association.

Ménière's disease is a disabling condition characterized by prostrating dizzy spells, ringing in the ears and even deafness. Only certain cure for the condition so far discovered has been a delicate and difficult nerve-cutting operation. Search for a cure for the condition without surgical operation led to the announcement by Mayo Clinic physicians two years ago of histamine as a chemical remedy for the disease. Nicotinic acid, however, succeeds in many more cases than histamine, in Dr. Atkinson's experience. He reports recoveries under nicotinic acid treatment of patients who had relapsed after temporary improvement or gotten worse on histamine treatment.

The histamine treatment was based on the theory that the patients were sensitive to this chemical which is normally produced in the body, somewhat as hay fever patients are sensitive to pollens. The treatment consisted in giving doses of histamine to desensitize the patients. Less than one fourth the patients, Dr. Atkinson finds, are actually sensitive to histamine. Inexperience with the test for histamine sensitivity, he believes, has led doctors to use the treatment for many patients who are not sensitive.

At first this treatment seems to help even the large group that are not sensitive to histamine, because this chemical acts to dilate the small blood vessels. But these patients sooner or later develop a resistance or immunity to the histamine action on small blood vessels. Then their small blood vessels become more constricted than ever, and the patients are worse off.

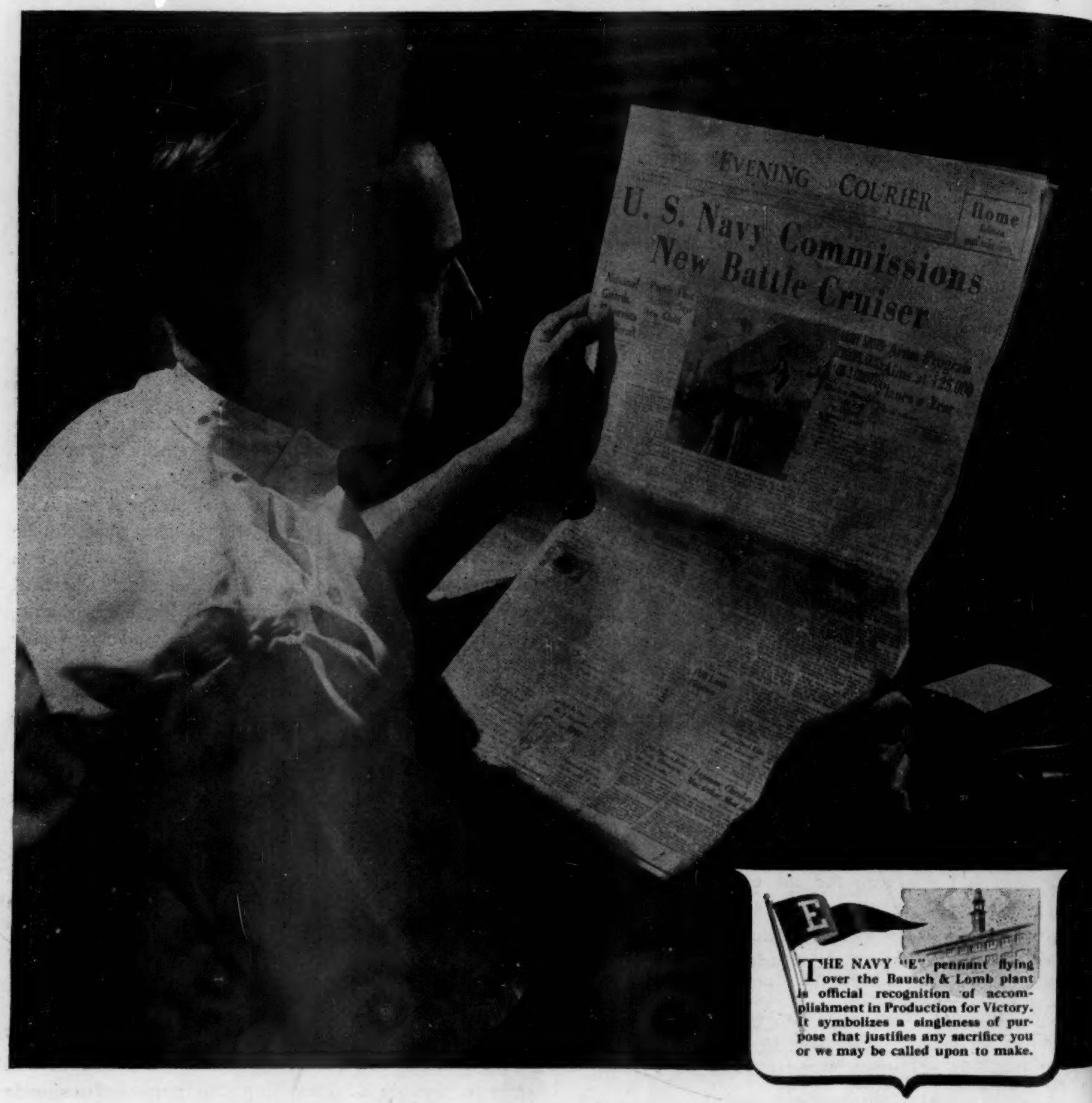
Nicotinic acid, like many other chemicals, dilates the small blood vessels, but patients do not become immunized to its effect, so it continues to help them over long periods, and, of course, it is safe to take for indefinite periods. A still better chemical remedy for Ménière's disease may be discovered, Dr. Atkinson points out, but nicotinic acid is the best that he has found as yet.

ITEMS

ACCORDING to reports from Dr. Ellice McDonald, director of the Biochemical Research Laboratories at Newark, Del., and Dr. V. W. Murray Wright, of Philadelphia, a new chemical remedy against germs, expected to be particularly useful in treatment of war wounds, has now been tested on ninety patients in the Philadelphia hospitals. The new remedy, H–1, is extracted from germs that live in the ground. It has proved very effective against infections with germs in the gram-positive group, which are the ones found in 80 per cent. to 90 per cent. of wounds.

DISCOVERY of a new parent chemical for vitamin A which will double the amount of the vitamin that can be obtained from whale and probably other fish liver oils was announced at the meeting of the American Chemical Society by Dr. Norris D. Embree and Edgar M. Shantz, of the laboratories of Distillation Products, Inc. Whale liver oil contains a chemical, named kitol, which can be turned into vitamin A in the laboratory by simply heating the oil to 500 degrees Fahrenheit. The kitol of whale liver oil has hitherto been discarded as an impurity when vitamin A was extracted from the oil. Its ability to become vitamin A was not suspected because animals can not convert kitol into vitamin A as they convert the green and yellow coloring matter of plants into the vitamin. On the other hand, carotene or the other vitamin A parent chemicals has not been converted into the vitamin in the laboratory. Kitol occurs most plentifully in whale liver oil but is also found in all other liver oils except those of certain fresh-water fish.

ADDED to the recent troubles of Hawaii is the discovery by Joseph E. Alicata, that a common rat flea of the islands is capable of spreading the germs of endemic typhus fever. This is not the European typhus fever dreaded as a war plague, but the much milder variety found in non-epidemic form in the United States. Reporting his discovery to the Washington, D. C., Academy of Sciences, Mr. Alicata explains that he let sticktight fleas feed on laboratory animals infected with typhus fever germs, to see whether or not this kind of flea, like some of its relatives, could pick up the typhus fever germs and pass them to other animals. The finding that it can do so is of considerable interest because sticktight fleas are commonly found on rats, dogs, cats, mongooses and chickens in the islands. According to one survey, sticktight fleas were found on 13 per cent. of rats trapped in Honolulu and made up about half the fleas collected on rats of the island of Oahu. Fifty-nine cases of typhus fever were reported in Hawaii in 1941, but health officials do not know whether these were endemic or European typhus fever.



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